H ENGINEERING CONSTRUCTION WEEKLY

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Engineering NEWS-RECORD

July 15, 1937

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Back to First Principles

SPEAKING to the Boston Chamber of Commerce a few weeks ago, Colby M. Chester, Chairman of the National Association of Manufacturers, threw a brilliant spotlight on the true functions and objectives of industry as against the warped half-truths that are served up so consistently by partisan spokesmen and advocates.

Mr. Chester sees the need for increasing purchasing power in the hands of the people, but he knows that it cannot be realized by merely using the taxing power to rob a few Peters to pay a multitude of Pauls. Like all business men he wants prosperous business, but he knows that it cannot be achieved by arbitrary or manipulated cuts or increases in prices. While he does not say it in so many words, it is safe to infer that he knows also that widespread abundance cannot be won by building up a permanent horde of federal dependents, encouraged by a professional Santa Claus playing with the credit of a nation, to demand a governmental bounty as their right.

For Mr. Chester tells us very clearly and correctly that the key to that abundance must be sought "in increasing the earning capacities of those in employment and in increasing their number; and," he continues, "probably the best way to do that is to increase production while maintaining the lowest competitive price levels."

Note that he bases purchasing power on earning capacity and increased volume on competitive prices. On no other bases can either of these essentials be soundly and, therefore, permanently achieved.

ONLY BY INCREASING the productive capacity of the individual can we increase his earning capacity and *hold it at the higher level*. It cannot be done by statute or by industrial strife; we cannot divide what we do not produce, however effectively we may fool the people into thinking otherwise. And when we try to do it we are but consuming our capital and heading into desperate and disastrous courses.

Neither can we maintain the increased production required to provide employment if we fail, as Mr. Chester puts it, "to maintain the lowest competitive price levels." For that is necessary if we are going to broaden our markets sufficiently to absorb the greater production. And if we think that we are beating the game in our own interest by maintaining fictitious, non-competitive price levels we are but fooling ourselves. We are, in fact, drying up demand by reducing the number of potential customers by curtailing the purchasing power of each of them or by opening the door to substitute products or services.

Mr. Chester knows also that the answer to our problem is not some *one* of these measures, ridden to absurd excess, but rather the rational *combination of them all*. And that can be achieved only by a free, competitive industry, subject to no more statutory regulation than is necessary to conserve the essential rules that he lays down.

TO OBSERVE AND FORWARD these elementary principles is the true social mission of industrial leadership. By more efficient methods, machinery and management, the enlightened leaders of every business and industry are trying to maintain what Mr. Chester prescribes as the essentials of sound progress. In the name of business and under the incentive of business profit, but actually in the interest of true social progress, they are trying to make jobs for more people and to increase their earning capacities in those jobs. The record shows that over the last fifty years they have been amazingly successful in that job and there is every reason to believe that they can better that record during the next fifty.

Dislocation in the industrial mechanism is bound to occur. From time to time, and not always from the same cause, it breaks down more or less completely. But the way to strengthen the machine is not to wreck it, and the way to smooth its operation is not to foul its bearings. Mr. Chester points out the fundamentals; we shall be able to cope with the evils only as we remember those fundamentals and stick closely to them.

Willard Chevalier

·ENGINEERING NEWS-RECORD·

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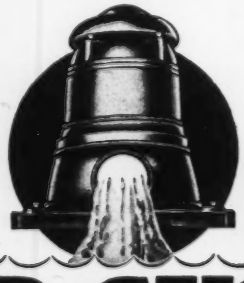

LAYNE PUMPS
WELL WATER SYSTEMS

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VOL. 119 *JULY 15, 1937* No. 3

THIS WEEK AND NEXT

THE WORST CONSTRUCTION accident of last year was the collapse of a New York City apartment house in which 18 workmen lost their lives. In this issue, Elwyn E. Seelye, one of the engineers appointed by the court to investigate the collapse, reviews its causes and discusses ways and means of improving city building laws and practices to the end that the public may enjoy the safety to which it is entitled.

Pertinent discussion of how to finance water improvement is made by Arthur W. Consoer, an engineer of long experience in water supply development.

Continuing the analysis of Detroit's successful paving operations begun July 1, C. A. Proctor and C. L. Shattuck in this issue tell how precise control is kept over all processes of manufacturing asphalt.

Chlorine, properly controlled in the water plant, is man's strongest defense against disease; chlorine uncontrolled deals death. How leaky chlorine containers can be made safe is described on p. 100.

The remarkable bridge building program of New England was told in general terms last week. This week Mr. Bowman gets down to details of the bridge building operations.

New records for concrete placing have been set up at Grand Coulee Dam through close integration of all processing and handling. Details are given on p. 101.

NIGHT LIGHTING of major trunk highways will be the next great forward step in highway development. Beginning in August, Engineering News-Record will publish a series of articles giving the most up-to-date information on the possibilities and problems of this new science.

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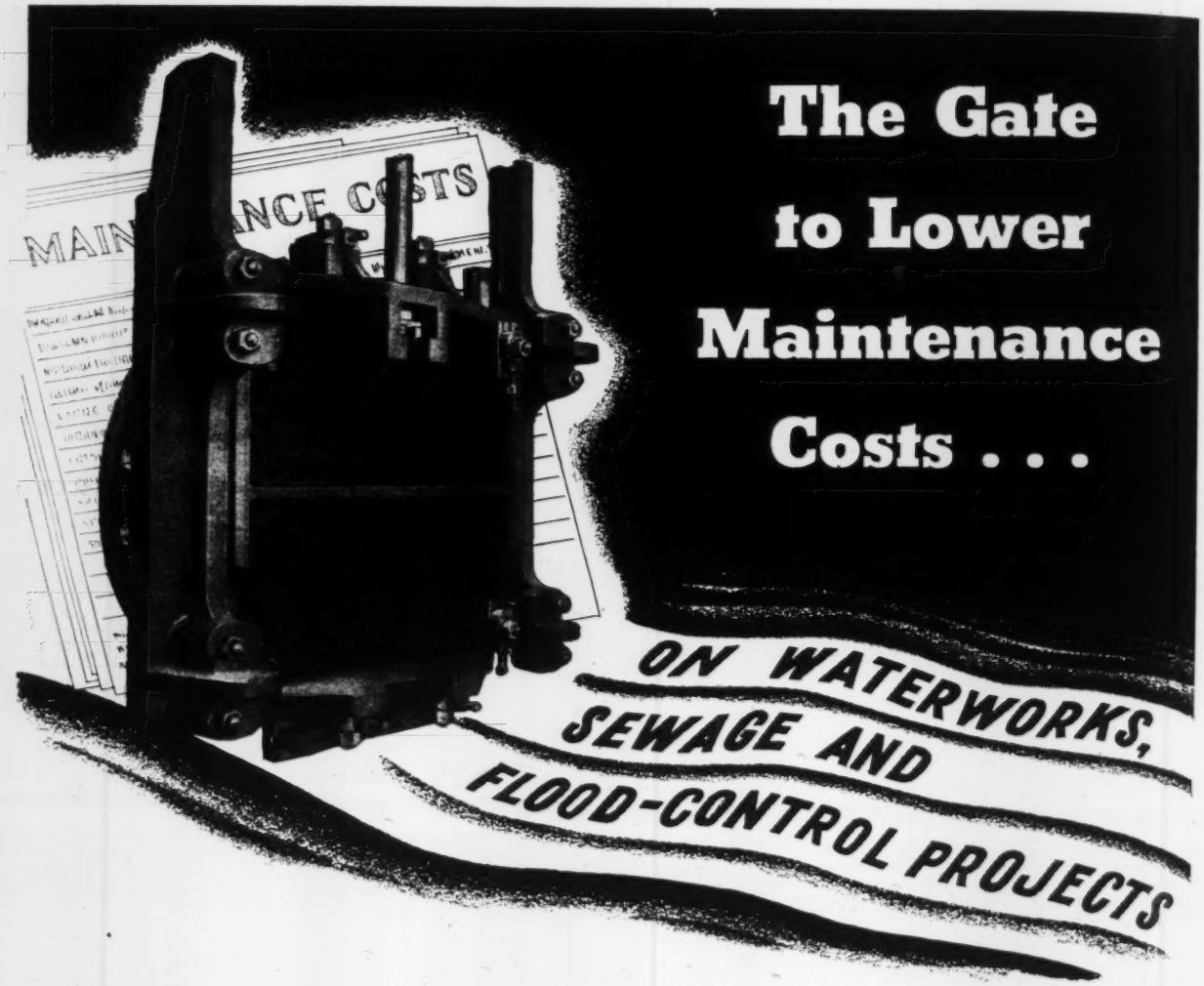
THE COVER PICTURE is a view down the spillway of Alamogordo Dam on the Pecos River in New Mexico being built by the Bureau of Reclamation. The energy of the falling water is dissipated in the pool at the bottom of the spillway.



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THE WEEK'S EVENTS

Water District Won't Unionize

Southern California district is not subject to Wagner Act, Board states

As a political subdivision of the State of California the Metropolitan Water District of Southern California is not subject to the National Labor Relations Act and will not restrict employment on the Colorado River aqueduct to members of any single union, according to a statement of the district's employment policy issued by its board.

W. P. Whitsett, chairman of the board, issued the statement July 2 following the appearance before the board at a previous date of a delegation speaking for "Local Union No. 270, Aqueduct, Subway, and Tunnel Workers, an affiliate of the Committee for Industrial Organization." Spokesmen of the union group requested a "closed shop" agreement with the district.

The district board's statement is summarized as follows:

1. The Metropolitan Water District of Southern California is a political subdivision of the state of California, and by the express terms of the National Labor Relations (Wagner) Act is not subject to that act.

2. It is unlawful for the district to enter into any agreement which will limit or restrict the right of citizens qualified for the work and residing within the district to obtain employment on the Colorado River Aqueduct.

3. This Board cannot and will not restrict employment to members of any single union.

4. Our investigations have failed to reveal that any city or district in California has entered into any "closed shop" agreement with any union.

5. The responsibility for the construction of the aqueduct is by law imposed on the board of directors.

6. This board has not and will not foster, encourage, discourage, or oppose the joining of any lawful organization by any of its employees.

7. It will continue to be the policy of this board to treat with the representatives of any group of employees or any individual employee, through the staff of the general manager.

8. Throughout the construction of the aqueduct this board has earnestly endeavored to maintain superior living and safe working conditions for its employees. Wages have been increased from time to time as warranted by changed conditions.

9. This board has by ordinance set up fair rules and regulations governing all district employment.

MAJOR NEWS

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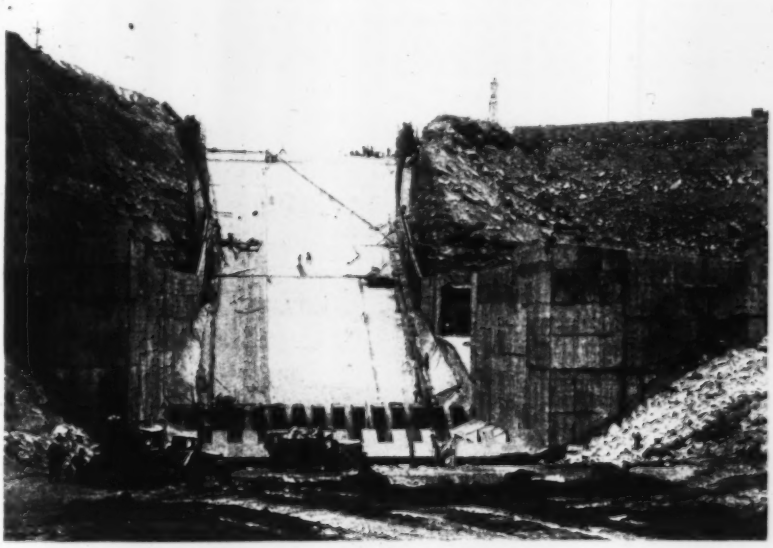
Arizona Road Builders Sign AFL Contract

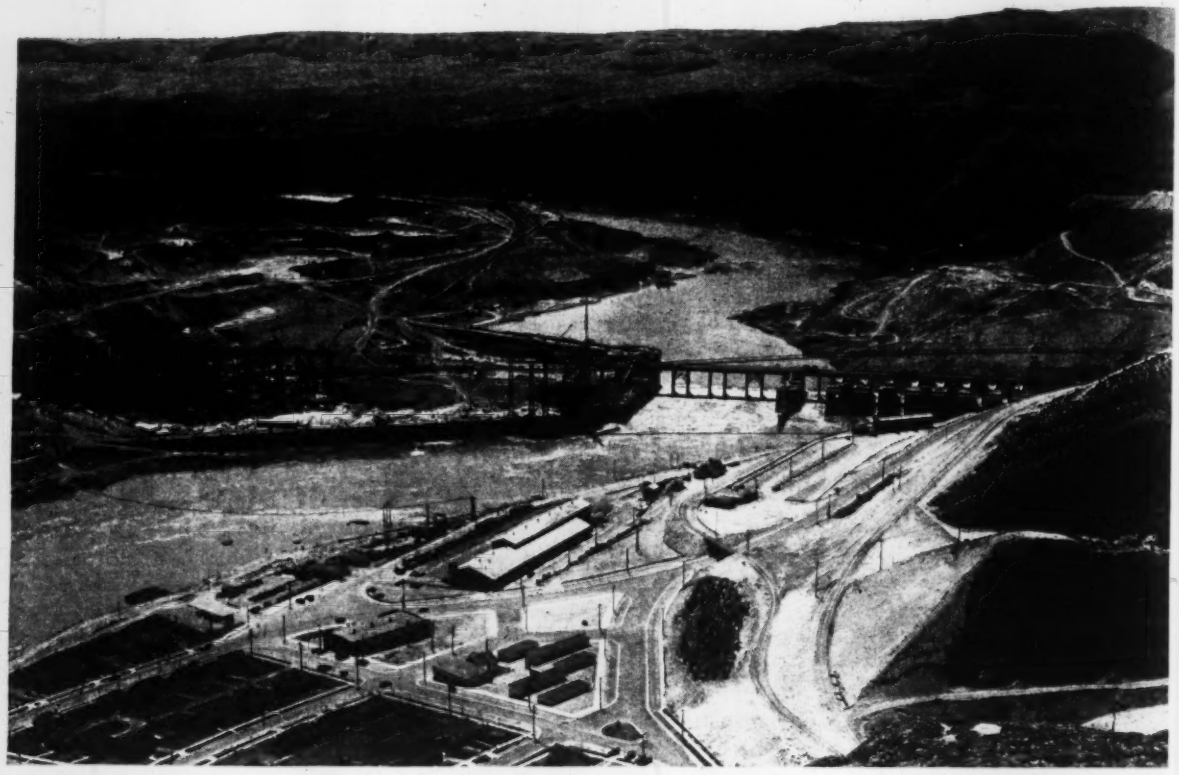
Twenty-four contractors enter agreement; outside firms expected to participate

A closed shop agreement with the American Federation of Labor has been signed by 24 highway contractors in Arizona, all members of the Arizona Chapter of the Associated General Contractors of America. However, the agreement is with the individual contractors and not with the chapter as a whole. It was negotiated by Jos. P. Condrey, secretary of the chapter, Phoenix, and A. H. Peterson, Pacific Coast representative of the AFL. Outside highway contractors operating in the state are expected to become parties to the agreement. The wage scales will be set from year to year based on the highway department's rates.



INCOMPLETE SPILLWAY PASSES FLASH FLOOD

A MAJOR flash flood with a crest exceeding 50,000 sec.-ft. recently piled up behind the incomplete Alamogordo Dam on the Pecos River in New Mexico, spilled over the spillway and passed down the river without damage to the town of Carlsbad. The dam is being built by the U. S. Bureau of Reclamation to provide supplementary storage for the Carlsbad reclamation project. It is an earth and rock fill extending to the right of the spillway. The spillway is cut in the rock cliff and paved with reinforced concrete. Another view of the spillway is on the cover of this issue.



GRAND COULEE DAM AS HIGH WATER COMES IN THE COLUMBIA

THIS PICTURE shows in a remarkable manner the great size of the east cofferdam at Grand Coulee Dam. The Columbia River, which is high at this season of the year, is now diverted to flow over low sections left in the east end of the dam. Seepage under the high section of the cofferdam in midstream late this spring and collapse of some inner cells for a time threatened flooding of the east cofferdam, thus delaying the work for many months.

Major Kittrell Succeeds Col. Larkin at Fort Peck

Lt.-Col. Thomas B. Larkin, U. S. district engineer in charge of the Fort Peck Dam project in Montana since Nov. 21, 1933, leaves that position on July 16 to enter the War College at Washington. He will be succeeded by Maj. Clark Kittrell, who has been chief of operations at Fort Peck since the start of the project. Maj. C. N. Irv moves up to the position of chief of operations. Capt. A. W. Pence, who has been in charge of driving the four diversion tunnels, now completed, and Capt. D. A. D. Ogden, in charge of dredging and dam construction, will soon leave the project, having been transferred to other duties. Capt. C. H. Chotpening assumes the responsibility for dredge operations and placement of the fill.

Col. Larkin has supervised the expending of over 39,000,000 man-hours of labor at Fort Peck and during his regime 62,000,000 cu. yd. of fill has been pumped into the dam, 14,000,000 cu. yd. of material has been excavated from the spillway, and 25,000 ft. of diversion tunnels has been driven. The diversion of the Missouri River on June 24 and corresponding closure of the center section of the dam marked the climax of his term of office at the project. A detailed account of the river diversion and dam closure will be given in next week's issue. From June 24 to July 7 more than 1,700,000 cu. yd. of material was pumped into the closure section.

* * *

Contract Let for Approach to Lincoln Tunnel

Contract for construction of the New Jersey approach to the Lincoln tunnel in Weehawken has been awarded by the Port of New York Authority to George M. Brewster & Sons, Inc., of Bogota, N. J., for $2,257,000. The section of elevated express highway, marginal streets and ramps included in the contract, will be located a short distance north of the Weehawken municipal building. The structures will be partly of steel and partly of reinforced concrete faced with granite rubble masonry.

TVA Unable to Allocate Cost of River Work

Inability of the directors of the Tennessee Valley Authority to reach a conclusion as to the proportionate cost to be charged to flood control, navigation, fertilizer, national defense, and power development in respect to facilities at Wilson Dam and the steam plants at nitrate plants No. 1 and 2 was reported to Congress July 8. The report was in the form of a letter signed by Harcourt A. Morgan, vice-chairman of the TVA directors, which was approved by President Roosevelt on May 6.

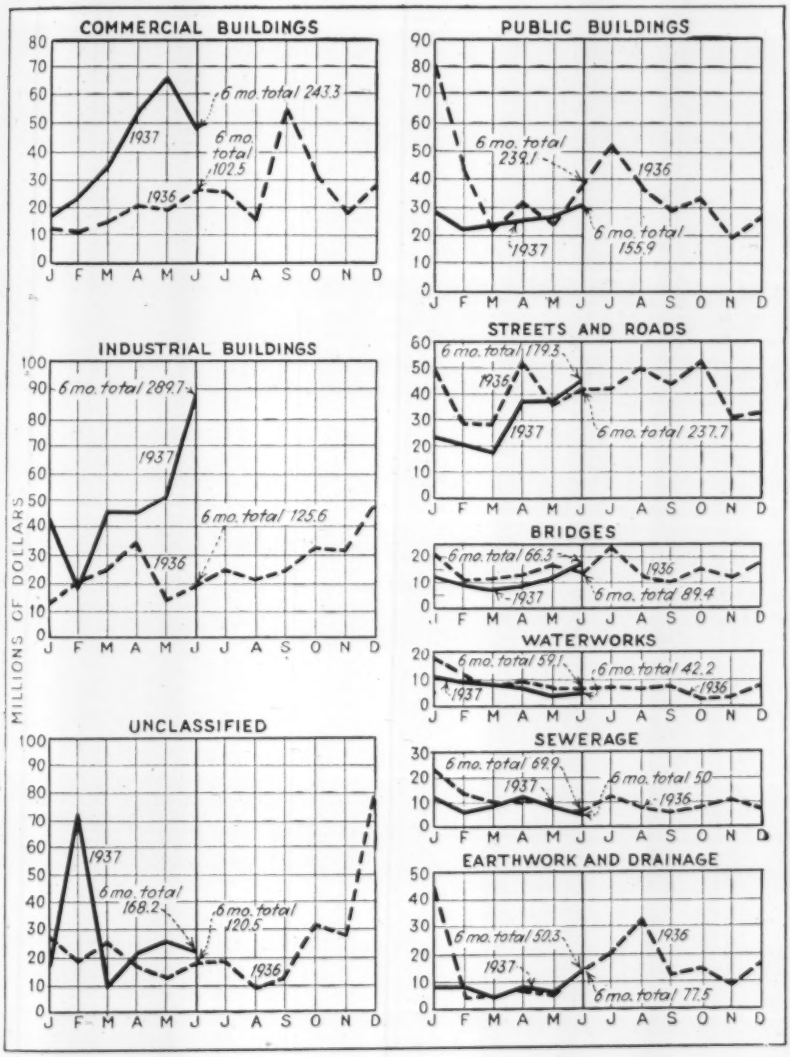
The cost allocation was directed in section 14 of the Tennessee Valley Act as amended, and was due Jan. 1, 1937. At that time Congress was notified that additional time would be necessary, and this conclusion is repeated in the present letter, which states that the studies are being carried further by the TVA board. It is also pointed out that the principles established in this instance will undoubtedly apply to other cases in the future in allocating the costs of multi-purpose projects.

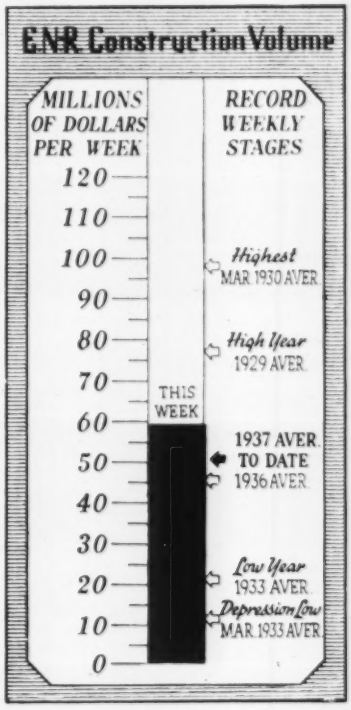
THE CURRENT TREND

This week's news of contract volume and construction cost factors

Good, Bad and Indifferent

Charted record of first 6 months in various classifications of engineering construction reveals a spotty picture in which private building is principal highlight





THIS WEEK'S FIGURES

CONTRACTS

(Thousands of Dollars)

	Week Ending July 16 1936	July 8 1937	July 15 1937
Federal	$8,505	$2,847	$3,826
State & Municipal	22,553	43,781	32,171
Total public	$31,058	$46,628	$35,997
Total private	11,631	20,370	23,440
TOTALS	$42,689	$66,998	$59,437

1937 (28 weeks).....$1,427,341
1936 (29 weeks).....$1,262,378

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

	Week July 15	Cumulative
NON-FEDERAL WORK	$210,265	$850,337
State & mun. bonds	6,560	291,506
Corporate securities	2,105	285,087
PWA loans and grants	1,600	43,915
RFC loans	.....	29,929
Fed. Aid for Highways	200,000	200,000
FEDERAL WORK	.....	.....
TOTAL ALL WORK	$210,265	

1937 (28 weeks).....$850,337
1936 (29 weeks).....$1,175,690

Engineering construction awards for this week total $59,437,000, a 39 per cent gain over the corresponding 1936 week. Private and public contracts increased 102 per cent and 16 per cent, respectively, over the 1936 week. The 1937 average week, $50,976,000, is 17 per cent above 1936 average.

Buildings and highways account for 75 per cent of this week's awards.

THIS WEEK'S LARGE CONTRACTS

Plant improvements, Republic Steel Co., Gadsden, Ala.	$2,000,000
Plant, Bendix Aviation Corp., Bendix, N. J.	3,000,000
Coke ovens, Ford Motor Co., River Rouge, Mich.	1,200,000
Apartment House, New York	3,000,000
New Hospital, New Orleans	7,312,000
Tallman's Island Sewage Treatment Works, Contract 2; New York	1,303,000
Portion Lincoln Tunnel approach, Weehawken, N. J.	2,287,000
Highways, Pennsylvania	1,453,000
Highways, New York	1,294,000

Fee Simple Options on Floodway Ended

Senator Overton of Louisiana says these efforts hinder flowage transactions

Instructions were issued by the Chief of Engineers last week to discontinue all efforts to secure options for the purchase of land in fee simple in the Louisiana floodways. This was done at the request of Senator John H. Overton of Louisiana who contends that the efforts to secure fee simple options is making it more difficult to secure options covering flowage easements through the floodway.

Senator Overton asked that this be done so that one more effort could be made to secure options on flowage rights. Thus far only a small percentage of land owners in the Eudora floodway have been willing to sign options.

Since the difficulty experienced in getting residents to move out of the New Madrid floodway the War Department is convinced that it should be in absolute control of the land between floodway guide levees. Senator Overton is convinced that if the options covering flowage rights are not forthcoming soon that the federal government will proceed to acquire the lands by condemnation. He thinks this would make much more likely the construction of the spillway that would be operated on a bank full basis. Rep. Will M. Whittington, the chairman of the flood control committee, and interests in the Yazoo delta are campaigning actively for a bank-full diversion. Under the Overton Act no water may be diverted from the Mississippi River into the Eudora floodway until the gage at Vicksburg will have reached the 51 foot level. This would mean that lands within the floodway would be overflowed only once in an average of 15 years.

• • •

Committee Will Revise Baltimore Code

A special committee has been appointed by Mayor Jackson, of Baltimore, to supervise revision of the Baltimore building code. The present code was adopted in 1908, and the engineering section was revised in 1924. Several weeks ago the Board of Estimate authorized the Department of Public Works to employ three engineers and two other employees to work on the code.

The committee appointed to supervise the work is composed of John M. Russell, construction engineer, the Municipal Bureau of Buildings; E. L. Crosby, mechanical engineer; Clyde N. Friz and Lucius R. White, architects; and a number of builders and business men of the city.

• • •

Ohio Errs by Giving Engineers Charter

Because Ohio law prohibits corporations from practicing the engineering profession, Attorney General Herbert S. Duffy, of Ohio, has filed suit to invalidate the incorporation charter granted the Power Cost Engineering Corp., Cincinnati. Assistant Attorney General Joseph P. Inneary, said the Secretary of State's office had made a mistake in granting the charter to the Cincinnati concern.

• • •

Cincinnati Proposes Bond Program

Flood protection, grade crossing elimination, highway and sewer improvement are included in a $20,217,000 five year bond program for Cincinnati. Of the total, Myron D. Downs, city planning engineer, states that at least $1,000,000 should be spent annually for three years on the flood control project. The program, if approved by voters, would run from Jan. 1, 1938, to Jan. 1, 1941.

• • •

Vanderbilt Motor Parkway Offer Is Accepted

Five public agencies have jointly accepted William K. Vanderbilt's Long Island motor parkway offer to turn the old toll road back to the public. These agencies are: the Long Island State Park Commission, New York City Parks Department, State Department of Public Works, and Nassau and Suffolk counties. This group plans to dispose of the land gift bit by bit.

• • •

House Passes Flood Bill of $105,000,000

The House approved July 9 an appropriation of $105,000,000 for flood control this fiscal year. The sum was authorized by the War Department's non-military appropriation bill, but the House stipulated that $52,500,000 of the flood money should come from the $1,500,000,000 work-relief fund. Previously the House had approved a $52,500,000 flood control appropriation. When the bill reached the Senate, that body doubled the figure.

Lupfer to Act as Head Of Civil Engineer Society

Edward P. Lupfer, executive engineer of the Buffalo Sewer Authority, began service as acting president of the American Society of Civil Engineers, July 9. Mr. Lupfer has been senior vice-president of the Society and accepted the post of acting head of the organization at the request of Louis C. Hill, president, of Los Angeles, who has been ordered by his doctor to take a rest. Mr. Lupfer will preside at the annual summer convention of the society in Detroit July 19–22.

• • •

Boston Water Tunnel Under Investigation

Comprehensive studies of the cost and benefits of a subterranean pressure tunnel to bring water into Greater Boston from the reservoir system to the west are now being made by a joint engineering board. A report is to be completed in December for legislative consideration.

The proposed tunnel would be about 32 miles long and 15 ft. in diameter with a branch about 3 miles in length to serve southern areas at Boston, and would extend from the terminal chamber of the Wachusett aqueduct (El. 278) in Sudbury to the heart of Boston and across Boston Harbor to Chelsea. Northern areas would be effectively served by this line, which would bypass existing reservoirs and deliver water to Fells Reservoir in Melrose (El. 271). The depths below the surface would range from 200 to 500 ft. and the tunnel would reduce the amount of pumping required for the Metropolitan Water District from a present 55 per cent of the total to about 4 per cent, including that also done by Newton and Brookline in connection with their own supplies. Alternative plans are also being studied, including step-by-step developments of the tunnel and various supplementary connections.

• • •

Robins Reports Against River Transit

Benefits to the general public resulting from cuts in transportation costs are not sufficient to warrant improvement of the Columbia and Snake Rivers at the present time, according to Col. Thomas M. Robins, War Department division engineer, in a report sent to the Senate Committee of Commerce. However, Robins believes that enough surplus power from the series

Rudy Arnold Air Photo

THEY USED THE NEW MARINE PARKWAY BRIDGE

ON ITS FIRST DAY of service, July 4, the Marine Parkway Bridge across the entrance to Jamaica Bay in New York City did a big business with beachbound travelers who wanted to sample the facilities of Jacob Riis Park, also opened that day after complete rebuilding by the city park department and the WPA. A notable feature of the park is the parking field which accommodates 14,000 cars and is said to set a new record in size of paved areas.

The Marine Parkway Bridge incorporates a 540-ft. lift span, longest highway lift yet built and only 4 ft. shorter than the railway lift span over the Cape Cod Canal, longest in the world. The deck of the Marine Parkway lift span and the 540-ft. through-truss flanking spans are of steel open-mesh type, painted green except for the traffic lane lines which are made with aluminum paint. Curbs are also painted aluminum.

of eight locks and dams, four in the Columbia between the Dalles and the mouth of the Snake River and four in the Snake, could be developed and sold within the next 50 years to make the project economically sound.

. . .

Union Acts for Draftsmen In Large Office

Acting under the provisions of the Wagner Act, representatives of the consulting engineering firm of Gibbs & Hill, Inc., New York, met recently with a committee named by the Federation of Architects, Engineers, Chemists & Technicians to negotiate a new schedule of wages and laws for the 250 technically trained draftsmen employed by Gibbs & Hill. The negotiations did not cover certain non-technical men, supervisors, and engineers.

Pay increases granted as a result of the negotiations range from $15 a month for men now getting the minimum rate to $5 for others, except for men previously scheduled for increases due to merit, where increases were higher. The work week was reduced from 39 to 37½ hours, with time and one half for overtime beyond 90 hours a year.

WPA Places Tower Tops On Queensborough Bridge

The granite tops of the four main towers of the Queensborough Bridge, left unfinished when the bridge was built and not touched in over 20 years, have just been completed by the WPA. These tower-tops have been the subject of litigation which has caused the 20 year delay. There were approximately 170 granite blocks, averaging 4 tons each and approximately 800 cu.yd. of concrete was poured around the box girders at the top of the towers.

. . .

S.P.E.E. Surveying Meeting

Over 50 teachers of surveying from schools throughout the country have registered for the Society for the Promotion of Engineering Education's summer surveying conference on Rainy Lake on the Minnesota-Canadian border July 25 to Aug. 7. The site of the conference is Camp Marston where civil engineering students from Iowa State College are receiving practical experience in field surveying during the first six weeks of the summer. Prof. J. S. Dodds, director of the camp since 1923, is in charge of the conference.

WASHINGTON HIGHLIGHTS

Special reports by Paul Wooton

CONFEREES on the War Department appropriation bill have agreed that the amount to be made available for flood control should be double that carried in the bill passed by the House. The House bill provided $30,000,000 for flood control in the Ohio Basin and $22,500,000 for flood control in the Lower Mississippi Valley. The Senate doubled the item in each instance. Upon the insistence of the House members of the conference committee half of the amount voted by the Senate is to be taken from the $1,500,000,000 relief appropriation. Due to the fact that so much of the work in the Lower Mississippi Valley is done by machinery it was provided that $7,500,000 of the $22,500,000 to be drawn from the relief appropriation would not be subject to conditions requiring the use of relief labor.

Interest in the natural resources legislation has shifted to the House of Representatives, with the announcement by Senator James P. Pope of Idaho, that the Senate committee has closed its hearings and consideration of the pending bill of Senator Norris, which would establish a national system of "authorities" based on the plan of the TVA. Senator Pope has reported that the sub-committee of the Senate Committee on Agriculture, which has been studying the proposed bill, will present a report within a short time. It is expected that the House Rivers and Harbors Committee, under the chairmanship of Rep. Joseph J. Mansfield of Texas, will begin an active study of the measure. Rep. Mansfield has a competitive bill which he is expected to press as a substitute of the Norris proposal.

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Maryland Court Upholds State Bond Issue

Maryland's $1,000,000 bond issue for the construction of a state office building at Annapolis cannot be referred to the people for a vote, according to an opinion handed down by the Maryland court of appeals.

The issue has been the subject of a long controversy and court action. After the session of the General Assembly authorized the issue and the

removal of the state offices from Baltimore to Annapolis, there was considerable opposition in Baltimore. A petition to submit the subject to a referendum was filed. The lower court upheld the petition and ruled that the people had the right to vote on the measure. This ruling has been reversed by the Court of Appeals.

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TVA Makes New Power Contract

The Tennessee Valley Authority on July 7 announced a new contract, and the revision of an existing contract dated July 17, 1936, for the sale of energy to the Aluminum Company of America to be used in expanding its activity at Alcoa, Tenn. Rates range from $24 per kw. per year for firm power to 2.27 mills per kw.-hr. for dump power. The total annual return to TVA will be approximately $1,500,000.

The interchange clause in the original contract by which the Aluminum Company agreed to furnish power for the construction of Hiwassee dam in exchange for an equivalent amount of TVA energy at Alcoa is liberalized to provide that after the construction period the power will be available for TVA distribution in northern Georgia in areas more accessible to the Aluminum Company's system than to that of TVA. Power will be delivered at Alcoa by a new 35-mile transmission line from Norris Dam that will operate at 154,000 volts.

• • •

PWA Allots $500,000 For Surveys

The Public Works Administration announced July 1 the allotment of $500,000 to the General Land Office, Department of the Interior, to be used for survey and re-survey of public lands, in several states and Alaska.

• • •

University of California Opens Pump Testing Lab

The department of mechanical engineering at the University of California has recently established a laboratory to study and test vertical-shaft pumps. The work of the laboratory will include research in the field of deepwell and propeller pumps as well as the acceptance testing of specific pumps.

Installation of the laboratory's equipment is nearly completed, and the testing program will be started this month. The seven initial projects include the investigation of the characteristics of new deep well pumps and the development of a pump testing code. Several pump manufacturers cooperated in developing the research program of the new laboratory.

Wide World Photo

CHICKAMAUGA LOCK GOES INTO SERVICE

NAVIGATION on the Tennessee River began using the new lock in Chickamauga dam near Chattanooga on July 7, although the dam has not been completed. To facilitate the passage of boats during the construction period the concrete sill of the upper gate has not been built. The lock chamber is 60 ft. wide and 316 ft. long; when completed the lock will have a lift of 55 ft. A view of the lock chamber was given on the cover of the July 8 issue.

• • •

Department of Interior Buying California Land

Secretary of the Interior Harold L. Ickes has announced substantial agreement with Miller and Lux, Inc., large California land holders, with regard to the acquisition by the Bureau of Reclamation of the company's water rights on the San Joaquin River required for the Central Valley project.

The Secretary approved an appraisal of $2,450,000 submitted by the special board of consulting appraisers for the Central Valley project. Miller and Lux has offered to sell its rights for $2,500,000.

The purchase of the water rights, however, will not be completed until a study of all the San Joaquin River rights has been made by the Bureau of Reclamation.

Title to the water in the lower San Joaquin River is needed by the government in order to make the Central Valley project effective through storage and diversion of water at Friant Dam on the upper river, south to the lands of Fresno, Tulare and Kern counties, and northwest to parts of Madera county. The crop lands on the lower San Joaquin River will receive a substitute supply diverted from surplus waters of the Sacramento River and to be delivered through a pumping system in the lower San Joaquin River.

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Building Time Extended On New Bridges

President Roosevelt on July 6 signed bills extending the time for beginning construction of a bridge over the Narrows of Puget Sound by one year, and the time of completion by three years; extending for one year the time for commencing a bridge across the Snake River between Clarkston, Washington, and Lewiston, Idaho; and extending for one year the time for commencing a bridge across the Wabash River near Merom, Ind.

First Aid Cost Charged To Accident Policy

A construction company in Maryland is entitled to establish a first-aid station and hire nurses, deducting the cost from the premium paid into the State Accident Fund, according to an opinion by Herbert R. O'Connor, Maryland attorney-general. The cost of such first-aid stations and attendants come under the heading of medical service, and should therefore be borne by the State Accident Fund, he held.

Mr. O'Connor's opinion was given in connection with a policy written for the James E. Shea Company, Inc., of California, contractor for the construction of the Montebello-Loch Raven water tunnel for the city of Baltimore. He points out that the state will benefit by this expense because of reduced disabilities from injuries due to prompt medical service.

• • •

Arkansas Court Approves Bonds for Additions

Arkansas municipalities may issue bonds for additions to public buildings as well as for construction of new buildings, according to a ruling by the Supreme Court of Arkansas June 28.

The decision was made in a test suit brought by B. C. Terry of Little Rock, taxpayer, against Mayor R. E. Overman and other Little Rock city officials, seeking to prevent a bond issue of $25,000, voted at a special election last January for an annex to the Little Rock Public Library. As it was contended that amendment 13 to the constitution of Arkansas did not specifically authorize bonds for additions to public buildings, the PWA had requested litigation to determine the question. The cost of the proposed annex is approximately $45,000.

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St. Louis Fund Set Aside For River Control

The East Side Levee and Sanitary District Board of Trustees, East St. Louis, Ill., has placed the proceeds of a recent sale of $500,000 in bonds in a special fund to pay for raising and strengthening 31 miles of riverfront and flank levees in that district. The proposed work would include the construction of a system of control works at Horseshoe Lake in Madison County.

The cost of the Horseshoe Lake project has been estimated at $225,000, while the rights-of-way for the new levees on the Mississippi River and damages to adjacent properties is placed at $275,000, according to a report prepared by E. F. Harper, chief engineer for the district.

The cost of raising and widening the levees has been estimated at $1,158,000, which would be paid by the U. S. War Department out of an appropriation under the 1936 flood control act.

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Frank T. Sheets Named New P.C.A. Head

Frank T. Sheets will become president of the Portland Cement Association Sept. 1, succeeding Edward J. Mehren, who resigned in May. (*ENR*, May 27, 1937, p. 797).

For four years Mr. Sheets has been consulting engineer and director of development of the association. Prior to that time he had been associated with the Illinois Highway Department for 23 years, and for 12 years was superintendent of highways and chief engineer.

FRANK T. SHEETS

He has served as president of the American Association of State Highway Officials, of the Mississippi Valley Highway Conference, of the Central Illinois section of the American Society of Civil Engineers, and was an official delegate from the United States government to the Pan-American Highway Congress at Rio de Janiero in 1929. He is the author of "Concrete Road Design, Simplified and Correlated with Traffic."

During the past few years Mr. Sheets directed the administrative and technical policies of the highways bureau of the Portland Cement Association and has directed industrial research to develop new and improved uses of concrete.

Unusual Flood in Ohio Town

Bellevue, Ohio, opens flood walls to let flood escape.

Failure of surcharged underground streams to carry away flood waters resulting from cloudbursts thrust the town of Bellevue, Ohio, into the necessity of breaking open the railroad embankment which surrounded it and usually protected it from flood to permit the water standing in its streets to escape.

A heavy rainfall occurred to the south of Bellevue on June 26, reaching cloudburst proportions in the neighborhood of the city. It was estimated that from 7 to 8 in. of rain fell at Bellevue between 3 o'clock in the morning and 12 noon. Flood waters backed up behind railroad embankments south of the city to a depth over the farmland of 20 to 30 ft. in some places. An underpass 30 ft. in some places. An under pass through the embankment was of insufficient size to permit the discharge of the surface waters through Bellevue as fast as it accumulated in the area to the south.

Streets at low-lying areas within the city became rivers flowing to a depth of about 4 ft. A great number of houses were flooded at the first floor level, and 90 per cent of the basements of the city were filled with water.

Under normal conditions surface rainage from Bellevue and the area surrounding it disappears into subterranean caverns. There are no surface streams in the vicinity of the city. It has been the practice since the founding of the city to dispose of sewage and surface drainage by constructing artificial sinkholes into the subterranean caverns.

The intense rainfall resulted in flooding these caverns to such an extent that they were no longer receiving the drainage entering the city. In some instances this flooding resulted in an upward flow from the caverns to the surface and in several places geysers 15 to 20 ft. broke through the streets. The upward flow appeared only in certain portions of the city, and in the surrounding country some low-lying farmland showed no flooding while higher farmland was covered with water.

Water Supply

The water supply for Bellevue is obtained from three upland reservoirs filled from small surface ditches during flood flow. The city has recently completed the construction of a modern water purification and softening plant which was placed in service a few months ago. The filtration plant itself

(*Continued on page* 116)

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Labor Worries Construction

The vital regard in which contractors hold the coming probability of a new order of labor relations is attested by the following comment on the results of the field survey reported in Engineering News-Record of June 24. An interesting indication of these comments is the strong support given to collective bargaining and contract agreements with labor. Not all have reached this point in their thinking but the evidence is increasing that a new feeling of mutual interest and responsibility is developing. The following letters are a notable contribution to a discussion that affects every construction contractor. —Editor

Sir:—After reading the report of the chaotic labor conditions throughout the country (*ENR* June 24, 1937, p. 913), I am impressed more than ever with the necessity of a state governmental determination of the rates of wages and conditions of employment binding equally the employer and the employed. At the present time the fixing of rates of wages and conditions of employment in New York state and Massachusetts is left entirely to the uncertain and haphazard demands of unskilled labor leaders with the result that no two construction projects pay the same rates of wages. These rates of wages and conditions of employment should be determined in relation to the economic value of the finished product, otherwise if the demands for increases that are being made at present are permitted to continue, it will mean curtailment of the industry with its consequent greater unemployment.

The Building Trades Council of New York city has seen fit to group together under one head the workers on buildings and the workers on heavy construction, which to my mind is all wrong. These workers constitute two distinct classes which from time immemorial have worked for different rates of wages and under different conditions of employment. I repeat that I believe the only satisfactory solution of this grave problem will be found after a state commission divides the state into zones and determines for each zone the rates of wages to be paid and the conditions of employment to be observed during a given period, and that these rates and conditions shall be maintained until the end of any construction project started within that period.

Unfortunately the employers of construction labor are so loosely bound and non-cohesive that it is impossible to present a solid front to resist successfully the unreasonable labor demands which are at present tending to curtail recovery in the construction industry.

Long Island City, June 29, 1937 — ARTHUR A. JOHNSON, President, Arthur A. Johnson Corp.

Sir:—Our labor conditions here in Buffalo are better and more stable than they have been in a great many years. While it is possible that some of the C.I.O. agitators may get in and disturb some of the men, I doubt if they will have any influence on the labor leaders. I believe the building trades here in Buffalo will not permit any deviation from their signed agreements, which are as good as we have ever had and perhaps a little better because they were drafted through truly collective bargaining, and the result has been that we understand each other better. Of course, wages were increased very materially here in some instances and they are now generally up to the 1928-1929 level, and in one or two instances are even a little higher. The greatest thing we have to fear is a possible labor shortage. In one or two trades, there are shortages at the present time because of the large numbers on WPA and welfare operations.

The lawlessness that has been permitted, if continued, may be a serious hazard. So, even though our own particular conditions in Buffalo may be the best, employers in general have a great nightmare facing them in the threat of a general strike and I, for one, feel that it is quite serious.

It is time for the Associated General Contractors to come out for a definite labor policy, not necessarily for an open shop, but one which would permit the chapters to adopt a definite labor policy and become strictly union if they so desire. With this set-up, the chapters should be advised by the association's national headquarters concerning all agreements and the chapters should then endeavor to make their labor conditions and working hours uniform or as nearly so as local variations will permit.

What we must avoid, by all means, is a reduction in hours below the now established 40-hour week.

Buffalo, N. Y., June 28, 1937 — J. W. COWPER, President, John W. Cowper Co.

Sir:—The article "Labor Worries Construction" correctly describes the labor situation in this territory for all practical purposes. Practically all trades here were given substantial increases in wages on June 1, and others are now making demands for increases. Trades demanding increases, however, are finishing jobs in progress at the old wage-scales.

A Building Trades Council is functioning in Chattanooga, and one is being suggested for Nashville, but the various crafts are apparently not united in this city. Common labor is well organized in Chattanooga, and on government work it is to the employer's interest to use men from that group rather than the incompetent and unfit men on relief rolls. Most of the crafts seem to realize the shortage of skilled labor and have noticeably increased the number of apprentices. No effort has been made to organize highway labor and it is doubtful whether the union could furnish skilled machine operators.

Nashville, Tenn., June 28, 1937 — W. F. CREIGHTON, President, Foster & Creighton Co.

Sir:—Our firm, employing about 500 men, operates mostly in Georgia, South Carolina, and North Carolina, but within the last year we have done some work in Alabama and the following reflects our experience in these states. Up until a few years ago a large portion of our operations were on state institutions and

local government projects, but the rules of PWA work scared us away from this type on all except two jobs. A large percentage of the work in this section consists of constructing low-cost housing projects and textile plants. These buildings can largely be built by rough carpenters and negro common labor with the exception of the plastering and the brick work. A large percentage of the rough carpenters are combination farmer-carpenters. There is a surplus of common labor. Farmers now get around 13c. for cotton and we believe that the wage rate on the farms is only about one-half our wage rate. Wages have been sufficiently high for masons and plasterers to encourage young men to learn these trades and there is no shortage at present. If and when the volume of high grade residence work, office buildings and apartment houses returns to its 1926-29 average there will be a shortage of extra good skilled mechanics, especially carpenters. The present wage rates, which are substantially the same as in 1929, will enable all types of labor to have slightly better standards of living than they had at that time.

There are a few cities such as Birmingham, Atlanta and Columbia, where there are some unions, but in general the union does not affect industrial work in these communities. We doubt if unionization of the construction force will occur except in a few of the large cities, because it would be practically impossible to get these combination farmer-mechanics to pay union dues and certainly impossible with negro farm labor.

During the worst of the depression the then RFC rendered very valuable service to all types of help. We understand that the WPA has now reached the point that it is impossible for them to get masons and plasterers on their projects unless they violate the rules. The WPA is getting the lowest type of carpenter, and is using the existing surplus of negro common labor and sorry white labor. Our latest PWA experience was that it was difficult to get mechanics through the then existing system. I venture to state that there is not a contractor in these three states who honestly thinks that another dollar should be spent through PWA rules.

Senator Byrnes' amendment to the relief appropriation bill would have been the best thing for the construction industry as well as for the taxpayers in general because it would have again put a large part of construction work on an economically sound basis.

A BUILDING CONSTRUCTOR.
Anderson, S. C.
June 28, 1937

Sir:—With reference to the report on labor conditions and the possible effect of unionism on construction labor rates published in your issue of June 24: A communication has been sent out recently by a union organization in Pittsburgh in which it is stated that contractors will have to pay 65c. for unskilled labor, 90c. for semi-skilled and $1.30 for skilled, regardless of wage rates stipulated by the state in its contracts. Add to these figures the requirements for compensation, public liability, old-age insurance, etc., which amount to 9 or 10 per cent, and with hour restrictions and other prescribed conditions the addition to the payrolls will be from 35 to 50 per cent.

A READER.
Hagerstown, Md.
June 28, 1937

Sir:—Locally we have in the past two years of established practically a universal closed shop in the building and highway fields, as compared to an 80 per cent open shop previously.

We recognized the necessity for a strong employers' organization whose sole purpose was to attend to collective bargaining with labor. To secure the support of the sub-trades and material houses whose truckers, and in some cases whose yards, were also threatened with unionization, we organized in the early spring of 1936 the Building Trades Employers Association of Milwaukee, patterned after similar associations in New York, Pittsburgh, Chicago, and other cities with possibly the greatest likeness to the Pittsburgh set up.

The last two seasons this association has handled all labor matters for its members and those non-members who come under union contracts, and have had the hearty cooperation of the local Building Trades Council and its constituent union, who, very fortunately, have outstandingly intelligent, honest and cooperative leaders.

The secretary of this new association is also and has been for a number of years the secretary of the General Contractors Association; the offices are adjacent, and the same stenographical service is available to both, but the two associations are in no other way connected.

The dues of the organization are based on the union labor payroll in Milwaukee County, and are equivalent to .001 per cent thereof.

S. M. SIESEL
President,
Siesel Construction Co.
Milwaukee, Wis.
June 29, 1937

Professional Engineers

Sir:—Mr. Roberti's letter which you publish in your issue of June 17 is the first objective statement of the contemporary engineer's status which has appeared recently but it seems to me that the writer is unduly reticent concerning the causes and the implications of the profession's position.

The position of the professional engineers today is exactly analogous to that of the American Federation of Labor. Both groups are trade unions which have snobbishly and undemocratically eschewed all connection with their natural associates, namely, the engineering graduate and the semi-skilled workman; both groups have adopted a paternalistic and patronizing attitude toward their apprentices worthy only of a medieval guild; both groups have bartered their individualism for opportunistic "advances" through legislation (labor laws, professional licensing) and now tremble before the Frankenstein monster which they have created.

When an aristocracy of any sort (in this case the aristocracy of technical leaders) is constrained to call in an outside mentor (the state via the politicos), that aristocracy is definitely beyond its heyday.

Nothing demonstrates better the arbitrary nature of a law foisted on the public by a truculent minority than the total lack in the licensing laws of a systematic and universally applicable method of securing a license. It is literally true that no one in New York State can secure a license unless he kow-tows successfully to a board of five men.

—C. E. MANSION
Albany, N. Y.
June 21, 1937.

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JULY 15, 1937

EMBODYING THE HIGHEST TYPE of engineering skill, the personality and career of Daniel E. Moran brought to his profession more than the inspiration of rare ability. It is distinction indeed to lead one's colleagues and followers forward as Moran did through his creative genius and his penetrating observation of every soil and foundation condition. But Dan Moran achieved yet more. He added so greatly to foundation-building practice as to transform what before his time was little more than a random activity into a well-established art. He did this both through his practical accomplishments and through his inquisitive searching into the mysteries of soil action and his constant questioning of the why and wherefor of the accepted rules of foundation work. A pioneer in settlement and consolidation studies, he was too modest to give his experimental work full public knowledge; yet he shares with Terzaghi the credit for marking out the line along which the mechanics of compressible soils was destined to advance. Insofar as the coming generation is enabled to deal with foundations by something approaching scientific method in place of the crude empiricism of even two decades ago, Dan Moran's genius must be given a substantial part of the credit.

Bridge Floor Development

FOUR YEARS AGO the first bridge with open-mesh flooring was put into service, the University Bridge at Seattle. Exceptional circumstances were back of the innovation: the need for greater width and capacity without costly strengthening of the trusses compelled the city's engineers to save weight by eliminating the former heavy floor. Service experience was so favorable, however, that the city equipped other bridges with the same type of floor (for report of first year's experience see *ENR* Sept. 20, 1934, p. 376), and since then some two or three dozen bridges elsewhere have been built with similar grid decking. Nevertheless the opening of the Marine Parkway Bridge last week, with a length of some 1700 ft. of this type of floor, is by far the largest demonstration it has yet had. The grid floor is the most radical answer that has been given to the persistent problem of eliminating excess dead weight in bridge floors. Its outstanding claim is that it saves enough weight to increase the live-load capacity by one-fourth to one-half or more, or for given live load so reduces the weight of large bridges as to increase their economic range. If its performance on the Marine Parkway Bridge confirms the results obtained on other bridges it will mean the permanent addition of a valuable new resource to road bridge practice.

Gains by Bargaining

IT WAS INEVITABLE that collective bargaining under union auspices should begin in the larger engineering and architectural offices as soon as the possibilities of the Wagner Act were realized. Inequalities in pay between organized trades as carpenters and unorganized technical men naturally convinced the latter that better pay would come with organization. It also was inevitable that the bargaining should result in some pay increases, since times are better. But many a man must be asking himself today whether the gain in pay is worth the price of the change in his status that comes with joining a union. Heretofore many of these men have considered themselves professional or subprofessional, members of groups in which the individual advanced by the special skill and personal interest that he put into his work. In a trade union, where the individual is swallowed up in the group, the dullard is maintained on a par with the able and energetic. The professional rank is gone. Those who put some store by the intangibles of life have this fact to weigh against the increases in pay that have been gained, or may be gained, by joining a union.

The Other Side

NOT A FEW MEN are saying that all this talk of the benefits of a professional status is bunk, that they would rather have a few more dollars in their pay envelopes as out-and-out union men than to starve as professional men. There are two causes for the disillusionment expressed in that statement. The first is economic, based on the law of supply and demand. Except for short periods, there always have been plenty of engineers, draftsmen and engineering apprentices. The inevitable result is low pay except for the few whose special skill lifts them out of the crowded lower grades. But the second cause is in part the responsibility of the employers, many of whom themselves are engineers. Not a few of these employers have exploited their technically trained employees. Under the circumstances the profession should not take too high-hat an attitude toward the union movement. It may bring some difficulties and may even upset estab-

lished routine, but the indications are that it will be temporary at best, and if it reduces the exploitation of young engineers the movement has a redeeming feature. In last analysis, of course, it merely exchanges exploitation by the employer for exploitation by the professional labor boss and mobster.

Opposing Viewpoints

CLEANING UP foundation rock in preparation for the first pour in a concrete dam is a phase of construction operations on which inspectors and engineers often clash. Their difference of view is natural. In a typical case the contractor, if left to himself, would say: "In this spot the rock looks bad: to avoid losing time on a small pocket we'll shoot out a 10-ft. lift over the entire pocket area," for work done in the bottom of the river is critical and the contractor has a good deal at stake. The inspector thinks differently; he is concerned with the $2 per yard for excavation and the $5 per yard for the concrete that replaces it. He says: "Take out a 5-ft. lift here in this worst spot, then we'll see whether any more has to come out." Possibly these opposing interests might be harmonized somewhat if the contract specified that in the foundation cleanup the contractor, on application, would be allowed to take out more rock than the inspector indicates, provided he pays half the additional costs for excavation and concrete. The contractor is entitled to elbowroom in critical situations.

A New Order Comes

THE CODE OF FAIR TRADE practices adopted by a leading group of Seattle contractors, noted in last week's News, indicates a definite trend in construction thinking. The code practices now in successful operation in Wisconsin highway work (*ENR*, May 27, p. 776) are another example. But the more notable indication of advance in thinking is the increasing practice of groups of contractors to set up contractual agreements with labor on wages and working hours. All the practices now being agreed upon have been picked from the overburdened construction codes of the badly planned N.R.A. They were recognized by construction then as sound procedure, but group rivalries piled regulation on regulation into a topheavy structure that was bound to topple even if its legal stability had been unquestioned. One of the promising indications of more stabilized construction is found in the voluntary agreements on fair practices being negotiated between contractors and between contracting and labor. The record of current labor conditions given in *Engineering News-Record* of June 24 and the comment since received from leading contractors support every belief that a new order of industrial relations in construction is beginning.

Unsafe Building

INCOMPETENT AND DISHONEST building has rarely been so well pictured as in the Bronx apartment house collapse of a year ago, analyzed instructively by E. E. Seelye this week. Not that the Bronx collapse is the first such case. On the contrary the history of building collapses is replete with instances of exactly the same underlying conditions, affecting some or all elements of the building operation—sometimes mainly the frame, at other times mainly the brickwork, or the footings, or the floor concrete. But often the confusion and the lack of evidence left the picture partly inferential. In the Bronx case, however, the investigations succeeded in giving proof complete enough to convince even a layman jury.

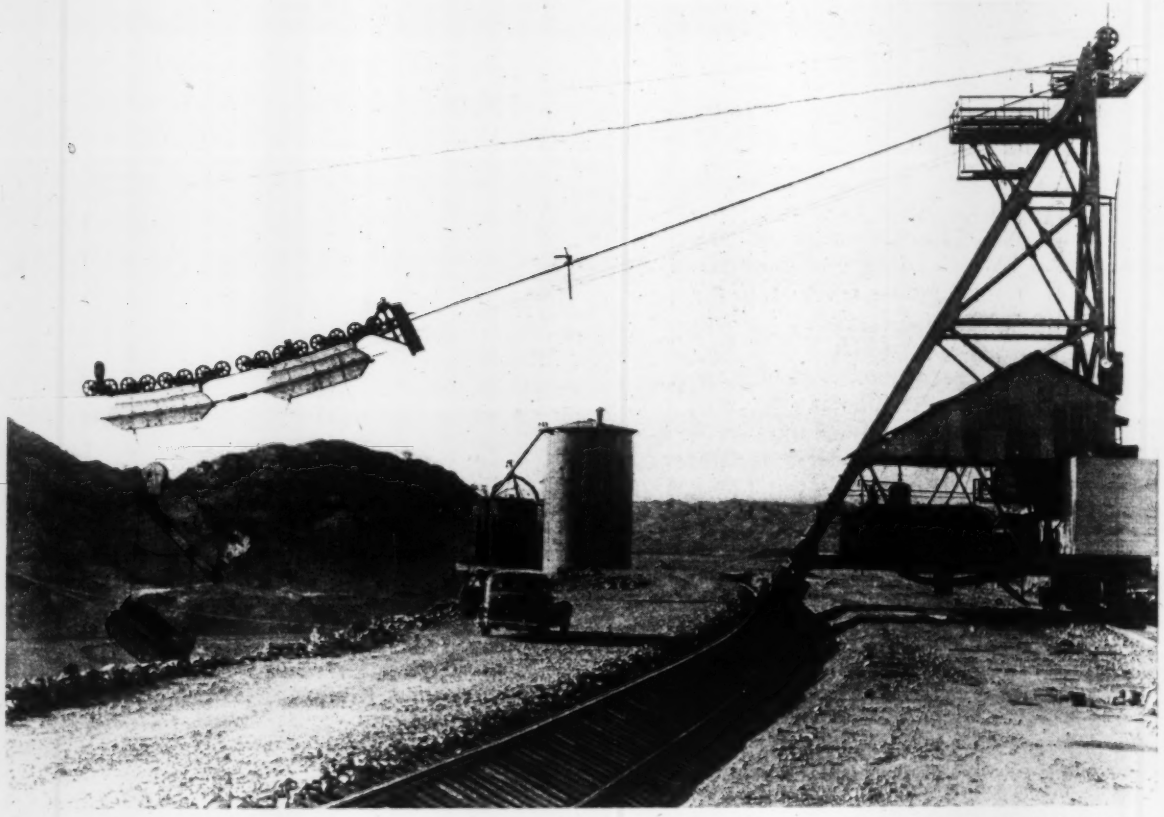
Building failures have often taught important technical lessons, as in the fall of the just-completed frame of the Darlington building in New York thirty-five years ago, which led to forbidding the use of cast iron columns in high tier building framework. But in such failures as the Bronx collapse there is no new lesson in technical methods of design and construction. The only issue is that of safe or unsafe building procedure.

It is obvious that ample safety factors are essential in building codes, to take care of unavoidable variables. But safety factors can never guard against the effects of utter incompetence, especially when dishonesty is coupled with it. Much of the time of municipal building inspectors is taken up with discovering attempts to evade the requirements of law and of good building. But even where dishonesty is absent the results of incompetence are apt to be fully as bad; in fact is it not necessary to assume that willingness to apply the rule of "anything goes" arises from causes other than ignorance.

So long as incompetent persons are allowed to build we will see more Bronx apartment house collapses. If these evil results are to be prevented it must be the first commandment of public building control to keep the incompetent out. Whether it is sufficient to require the owner to employ a skilled building superintendent, as suggested by Mr. Seelye, is a matter of opinion; but there can be no difference of opinion as to the need for making architect or engineer responsible for every building operation and requiring competent supervision.

Much has been said about the responsibility of the financing institutions for bad building. It can hardly be denied that unsound building activities could not exist without their support. But regardless of action by banks and mortgage-lenders, it is self-evident that to stamp out incompetent building it is necessary to restrict building to those who are competent. And the only direct way to this end is through the building law.

PICTURES IN THE NEWS



Metropolitan Water District Photo

AT PARKER DAM *the cableway swings buckets with remarkable precision or drops material just where it is wanted with great accuracy although the men in the towers on the canyon rim have no view of what is going on down in the river bottom. The secret lies in an operator, said to have the softest job on the project, seated at a strategic point in the canyon, who with electric signal and telephone maintains the necessary contact between the men on the headtower and those down on the job.*

CONSTRUCTION PHOTOS

EVERY construction job has possibilities for interesting progress pictures, or pictures of unusual features; and most jobs have amateur photographers who take such pictures. The purpose of this page is to publish, with proper credit for the photographer, as many pictures of this character as can be used. For details of the requirements see *ENR*, Apirl 22, p. 607.

Lessons from a Building Collapse

by ELWYN E. SEELYE,
Consulting Engineer, New York, N. Y.

Poorly-built New York apartment house, which claimed lives of 18 workmen, was product of a system of laws and habit which contains no safeguards against a repetition of the disaster not only in New York City but elsewhere.

When a tower on top of an apartment house under construction in the Bronx, New York City, crashed down through the floors last summer killing 18 workmen, the district attorney appointed a committee of experts to report on the cause. The author of this article was a member of the committee. Its studies coupled with the author's knowledge of New York City building practices give the suggestions he makes in this article authority and force. —Editor.

IN JUNE, 1936, a modern apartment house was being topped out in the borough of Bronx, New York City, when a center wing collapsed, causing the death of 18 workmen and, as a sequel, the conviction a year later of six men having to do with the design and construction of the building. The concern of the engineering profession with this tragic failure of one of its structures is threefold: (1) What was the cause of the accident? (2) How could it occur? (3) What measures are needed to make its recurrence impossible?

The structure, facing on East Mosholu Parkway, was a six-story apartment with brick bearing walls supporting the floors, except in a few cases where steel columns and girders performed this function. The floor and roof beams were of wood, excepting the first floor and corridors, which were of cinder concrete and steel. The front on the Parkway consisted of three protruding wings with courts between. On top of the middle wing was an ornamental tower about 25 ft. high, which was supported by two steel girders whose outer ends rested on the front wall of the building while their inner ends were carried by a steel bent. A similar construction would be the support of a water tank. It was the failure of this tower and its essential framing that precipitated the collapse of the front wall of the building as shown on the following page in Fig. 1.

In the framing support of this tower (Fig. 2) it will be noted that the 14-in. 123½-lb. girders had a short bearing on the wall of not over 9 in., and that there was no distributing grillage under them, although the dead-load reaction was about 26 tons. Also, the girders were slightly over the jamb of the window below, and the spandrel wall section was supported by two 4-in. channels and a 3-in. angle with a 4-in. bearing on the pier.

In the trial of the contractor-builder, the architect, the masonry contractor, the plan examiner and the building inspector, which followed the collapse, it was contended by the defense that the two 10-in. I-beams in the front wall (Fig. 2) served as grillages for the outer ends of the tower girders. This theory was rejected for the following reasons. In the first place, they had another function, that is, to support the overlapped parapet walls. Also, similar beams used in other parts of the roof were located above the roof. If the beams had been placed below the tower girders, they would have projected into the ceiling of the room beneath. Finally, the special though inadequate double-channel lintels occurred only over the windows directly under the tower girders; they would have been unnecessary if the 10-in. I-beams had been in place as grillages. The result of this reasoning was to establish the fact that the outer ends of the tower girders were supported solely by the masonry.

Under the framing arrangement that existed, the critical stresses on this masonry would occur on the jamb at the windowhead and would probably amount to 1000 lb. per sq. in. Investigation revealed that the mortar was over-limed and oversanded and that it was only a few days old when subjected to this stress. The conclusion that the masonry crushed under this load and that this crushing was the cause of the collapse is inescapable.

We may now well ask how such a failure could occur under modern building practices? It is the writer's opinion that the trouble originates in a low standard of professional morals on the part of the owner or builder. Bad construction is sure to result whenever an owner or promoter starts out with the prime idea of constructing a building at the lowest possible cost in the shortest period of time, and adopts the policy of "everything goes." And in spite of liberal safety factors required by law, such bad construction will eventually result in failures.

Defective work and materials

Numerous other examples of defective design and construction were found in examining the wreckage of the building. These may or may not have had an indirect effect on the actual collapse, but they are typical of speculative construction practice and are therefore significant.

In the section of the tower (Fig. 2) attention is called to the danger of buckling of the outside wall should the floorbeams not be properly anchored to act as ties. The standard anchorage detail shown was not actually attained because there were long stretches in the building where the anchors were omitted entirely or stopped short in more or less dry ma-

Fig. 1. Grim evidence of shoddy construction in a New York apartment house.

sonry areas as indicated in the pier section.

Such inadequate bracing of masonry walls in this class of building is a public menace just as much as is the omission of adequate grillages under concentrated loads coming on bearing walls.

Defective brickwork was particularly prominent, the building affording examples of dry masonry, inadequate bond, excessively wide joints, low grade brick, excessively lean mortar and badly proportioned walls. Fig. 4, for example, indicates how face brick headers were snapped, an expedient which made a saving in the more costly face brick but which tended to destroy the bond in the wall. Inadequate bond also created a tendency for the wall to split as shown in Fig. 5. In general, the bond between the mortar and the brick was very weak, and it was possible to pluck off bricks at many points. One possible explanation of this condition is that there is an idea prevalent among brick mason contractors that the mortar mix may be made leaner toward the top. This is just another instance of "everything goes." Add to these evidences of poor construction the 1½ in. thick mortar joints, the general low quality of brick shown in Fig. 5 and the use of deep chases in the bearing walls which did not

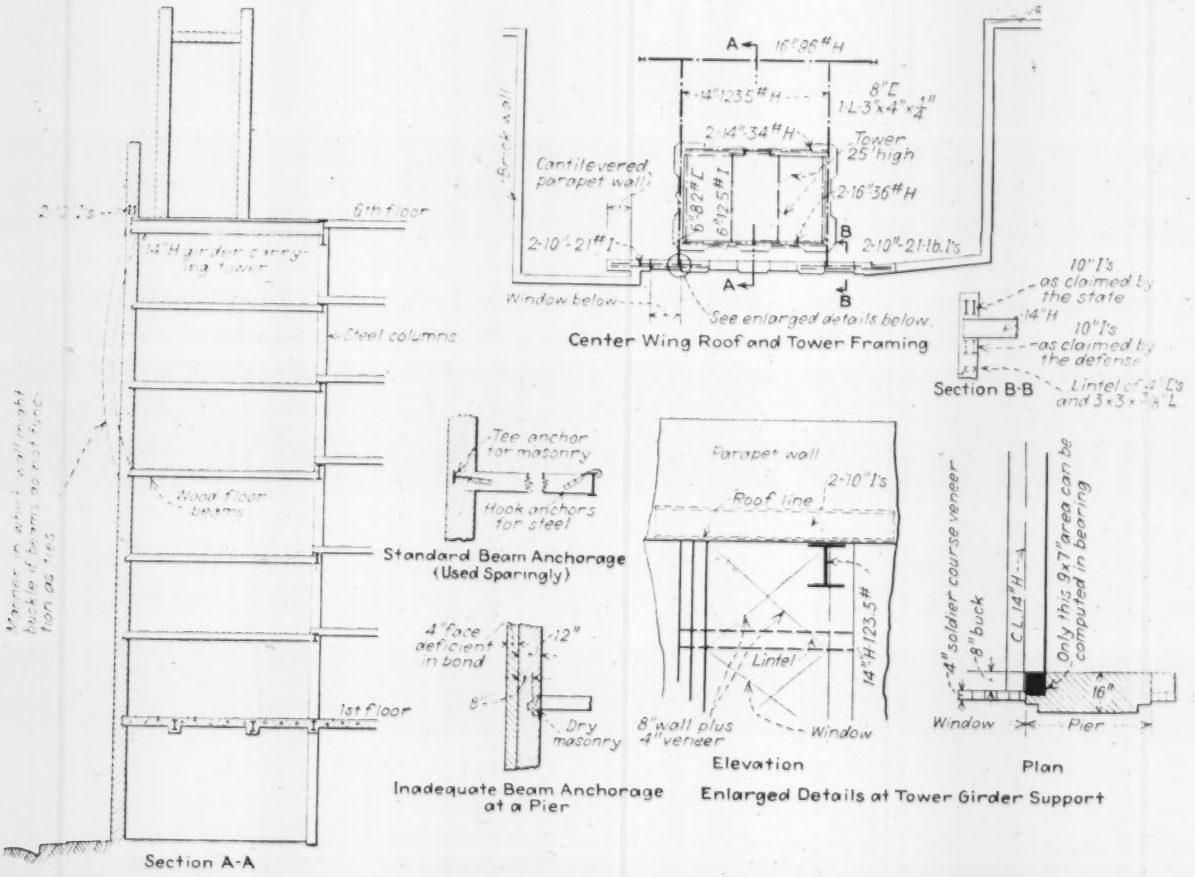


Fig. 2. Details of poor engineering which coupled with equally poor field work made the collapse inevitable.

improve their strength, and the indictment is complete.

While the quality of the structural steel on the job did not appear to have a direct bearing on the accident, it was nevertheless found that the steel included a large percentage of heavily rust-pitted second-hand material and that in some cases unused holes had been filled with mortar and painted over, apparently in an attempt to make the steel more marketable.

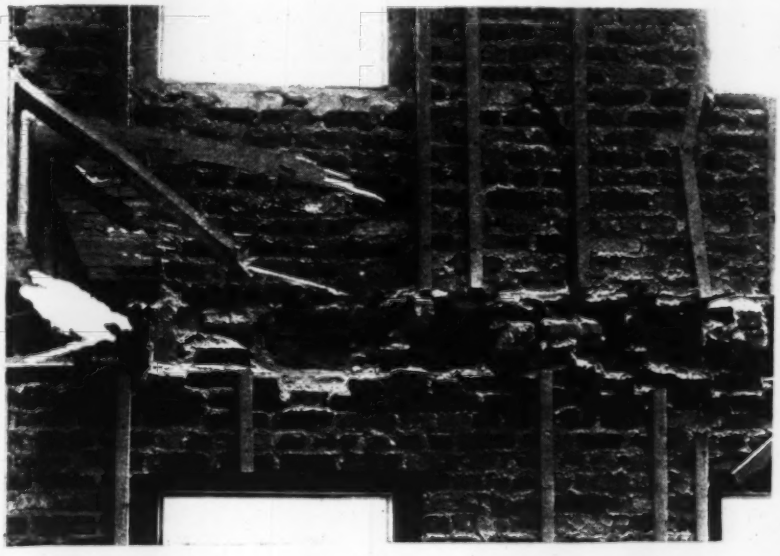


Fig. 3. Inadequate anchorage of timber floorbeams to walls. Note the lack of mortar in brick courses near beam locations.

Hybrid steel-and-bearing wall buildings are commonly thought to be simple to design; that all that is necessary is to proportion the beams and joists properly and follow the building codes for wall thicknesses. Nothing could be farther from the fact. These buildings require a higher degree of engineering skill than the simple steel skeletons because it is more difficult to visualize the problems and because the rules of design are more indeterminate.

For instance, the analysis of stresses in a brick wall containing a large percentage of irregular openings is not simple. Witness the difficulty of determining the stress in the pier jamb at the windowhead under the tower girder in this apartment building. Again note the difficulty of determining and providing adequate bearing for a concentrated load on a wall. Then, when is a wall a pier? Isolated piers require more conservative proportions than walls. Does the type of construction used on the apartment building permit its front wall to be classified as a wall or is it a series of isolated piers?

System basically wrong

It is evident that this type of building requires a relatively large amount of good-class engineering. Yet what kind of technical attention can be expected when the owner employs an architect to furnish both architectural and engineering services for a fee of around $1200 on a $300,000 structure?

And what about the subcontractors who in order to obtain the work must subtract their overhead and profit from the net figure, trusting in the owner's wink to the effect that "everything goes"? No wonder we find lean mortar, excessive bats, excessive snapped headers, holes in the steel filled with mortar, dry masonry, and beam anchors omitted.

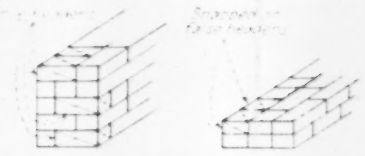


Fig. 4. Good and bad header practice. Snapped headers were a characteristic of the face brick on the apartment.

What about supervision? The architect is only asked to visit the job occasionally. There is no structural engineer of record. There is often no qualified superintendent other than a representative of the owner and he is interested only in driving the job to a point where the vital building loan payments start.

What about the city building department? Can an inadequate force of men harried by persuasive arguments, be expected to replace, with the few hours of their time allotted to such a job, the thousand or more hours which would be expended by an independent technician.

It is only fair to say that in the usual case the building department does not see the shop drawings and

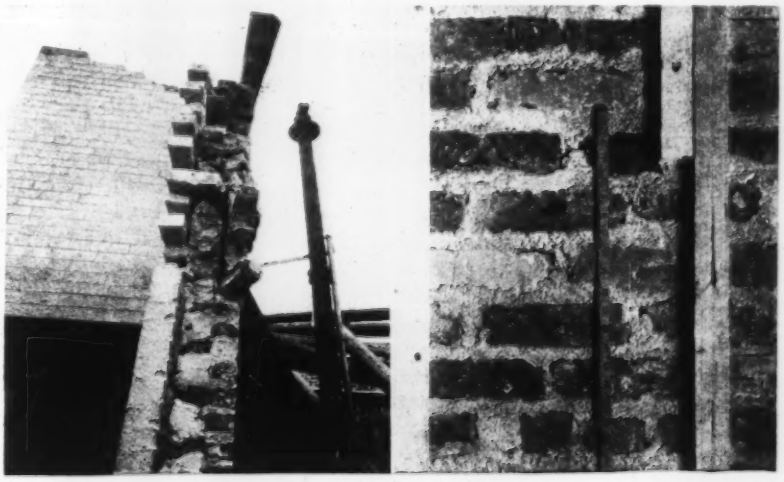


Fig. 5. Evidence of poor brick work. Left, splitting of wall due to lack of bond. Right, excessively thick joints of lean mortar.

that in this case the plans submitted to the building department did not show the inadequate 4-in. channel lintel which helped to place the 10-in. I's above the tower girders, as discussed above.

Does not this make clear how the defects described above, particular to this structure and common on most structures built under the speculative psychology, can occur?

What to do about it

Finally, as to a remedy, there are two courses open—namely, education and legislation. The publicity given to this collapse and the conviction of the builder, architect, masonry contractor, plan examiner and building inspector, should be valuable as an educational factor.

As to legislation, there is a strong movement under way in New York City to pass a law requiring an architect or engineer not only to supervise all building work but to file an affidavit upon completion of the job that the work has been lawfully executed and in accordance with the approved plans. This measure does not go far enough. It should require a licensed building superintendent on every job. Such a man is to the safety of the construction end of a building operation what the skipper is to a ship, for starting a building operation is like embarking on a dangerous voyage.

Another need is to insure correct technical design and supervision. This means control by a qualified structural engineer. A licensed architect may be a qualified structural engineer, but usually he is not.

Architects and builders connected with a building operation are subject to indictment in the case of an accident and cannot take out an insurance policy to protect themselves. However, if it were shown that the safety of the structure had been delegated to a qualified structural engineer and building superintendent, it is extremely doubtful if an indictment would be found against anyone else.

Cities desiring to protect themselves from disaster similar to the Mosholu Parkway apartment collapse should require structural engineers to qualify as such and to take out a license. Also they should require that such a qualified licensed structural engineer certify to the correct design and execution of the structural portions of the building. Finally, the field work should be placed in charge of a licensed building superintendent. If a system involving these safeguards is not adopted, greed will continue to beget gambling and gambling will beget more disasters.

Seven Ways to Finance Water Supply Improvements

by Arthur Wardel Consoer

Consoer, Townsend & Quinlan, Consulting Engineers, Chicago

Elimination of leakage, distribution system improvements and increased volume of sales will produce savings to finance needed extensions

With the cessation of new PWA grants and the reduction in scope of the WPA program many cities are exhibiting a marked inertia in carrying out needed water supply improvements. Certain definite methods for liquidating water supply programs are available to the waterworks superintendent and practicing engineer.

1. A leakage survey will frequently produce enough savings in operating expense to pay interest and principal on a large issue of water revenue bonds issued to defray the cost of needed water supply improvements. At Park Ridge, Ill., recently the night rate was reduced by means of a water-waste survey and leak correction campaign from 930,000 to 330,000 gal. per day. This reduction produced savings of more than $40 per day and the city is now proceeding with a $175,000 program of water supply improvements without any increase in tax rate or water rates.

2. Construction of additional feeder mains, loop mains and other improvements in a distribution system will often produce economies in pumping cost sufficient to pay for the improvements in the distribution system.

3. Negotiations for sale of water at wholesale rates to nearby towns and to industries will sometimes result in financial savings for both parties and will enable the seller of the water to carry out needed additions and extensions.

4. Improvements in pumping station equipment will frequently prove to be self-liquidating. Recently the writer found centrifugal pumps in a municipal water pumping station operating with overall efficiencies of only 38 to 42 per cent. The argument for new pumping equipment was self-evident.

5. Studies of initial pumping pressures will frequently disclose possibilities of operating economies by varying initial pressures skilfully. Investigations of this type should be supplemented with studies of pressure throughout the distribution system at various times and under varying conditions of demand. The possibilities of creating areas of varying pressure should be investigated also. Such studies will usually show the money-making possibilities of expanding the pumping equipment with a view to the most economical operation and satisfactory service under varying conditions of demand on the system.

6. Soap savings will frequently finance a municipal water softening plant. In such cases a raise in water rates is not really an increase to consumers.

7. An iron removal plant will often effect large savings in labor for flushing mains and water wasted for flushing.

Asphalt Plant With Precision Control

by C. A. Proctor and C. L. Shattuck,
Engineer, Asphalt Construction, and Assistant Chemical Engineer, Detroit, Mich.

Automatic control of mix temperature, proportions and uniformity highly perfected in the new Detroit hotmix asphalt paving plant

The development of city-owned asphalt paving plant and of pavement restoration practice in Detroit was outlined in Engineering News-Record July 1, p. 25. One of the major agencies contributing to recent improved practices is the new asphalt plant built in 1935 with an attention to flexibility and automatic control that gives it outstanding prominence. In the article that follows description has been limited to essential functional elements of interest to the paving engineer.

—Editor

The asphalt-paved streets of Detroit, Mich., count up to 1,800 mi.; or stated in units of area, to 32,000,000 sq. yd. In a normal year enough asphalt mixture has to be produced for from 750,000 to 1,000,000 sq. yd. of resurfacing and repair work on these streets. To produce this volume of material the city operates five mixing-plant units, four of them rather old but recently remodeled and one built in 1935 that ranks foremost in size and modern improvements among city-owned hotmix asphalt plants in the United States. It is this new plant that is described here and it is believed that it has features of exact plant control of proportioning, mixing and temperatures that will interest paving engineers.

Storage and handling

The materials of asphalt paving mixtures are: Sand, stone, mineral dust and asphalt cement and these are all kept in covered storage and are taken through the necessary movements by the utmost in mechanical means.

Sand and Stone—The sand used, which is straight-graded material for sheet asphalt and which requires no blending, is delivered by car and unloaded by two electric cranes into a covered storage bin of about 3,100 cu. yd. The stone storage (covered) is located alongside the sand storage and separate from it, and this material can be handled when delivered either by car or truck, by the electric cranes into the storage bin which is of about 1,650 cu. yd. capacity. And also either sand or stone can be unloaded into the storage bins or directly into the bin above the feeders.

Mineral Dust—Mineral dust is received in bulk in box cars and is unloaded with a Fuller-Kinyon unloader to either a dust storage house capable of storing 300 tons, or direct to the dust bin alongside the plant which has a capacity of 75 tons and which is kept full at all times either by material pulled direct from the car or reclaimed from the storage house. The dust storage house and car siding are located about 200 ft. from the plant proper. This system of handling dust has shown considerable saving, not only because of the difference in price between bulk and sack material, but also in labor, as two men are able to unload a 40-ton car in about 1¾ hours.

Asphaltic Cement—Storage for 71,000 gal. of asphalt is provided by five 10,000-gal. tanks, one of 15,000-gal. and two of 3,000-gal. each. Also two 15,000-gal. upright tanks used to supply the old unit are connected into the system and can be utilized, if desired. The five 10,000-gal. tanks are mounted over a large concrete pit 6 ft. deep which facilitates repairs to valves, etc., and in case of any accident whereby the asphaltic cement overflows due to a valve break or from foaming, it can be reclaimed from the pit in good condition.

Three cars of asphalt can be spotted on the spur at one time, there being three unloading-valve connections spaced the proper distance apart so that there is no need to move the cars until unloaded. Two cars can be steamed while the third is being unloaded—two asphalt pumps being available for duty.

The feature of the asphalt-storage system is its flexibiliy. It is possible to pump from car to any one of the eight tanks; from tank to tank; from any tank to the mixer platform and return; from any single tank back to the car. Eight different kinds of asphaltic cement can be handled separately and used without being mixed with each other or can be blended accurately. All asphaltic-cement lines are steam-jacketed and insulated and each tank has an accurate float gage attached.

Preparing the aggregate

The sand and stone is fed to the drier from a large four-compartment hopper by two automatic feeders (reciprocating type with three plates each) which are synchronized with the speed of the drier. Easy adjustment can be made to regulate the ratio of stone to sand in a uniform flow and four separate aggregates may be fed in any desired proportion as may be required. The internally fired drier (72 in. x 36 ft.) has a 10-ft. combustion chamber and revolves at a speed of 9 r.p.m.; it will dry and heat about 75 tons of aggregate an hour, based on an aggregate moisture content of 4 per cent.

The temperature of the material

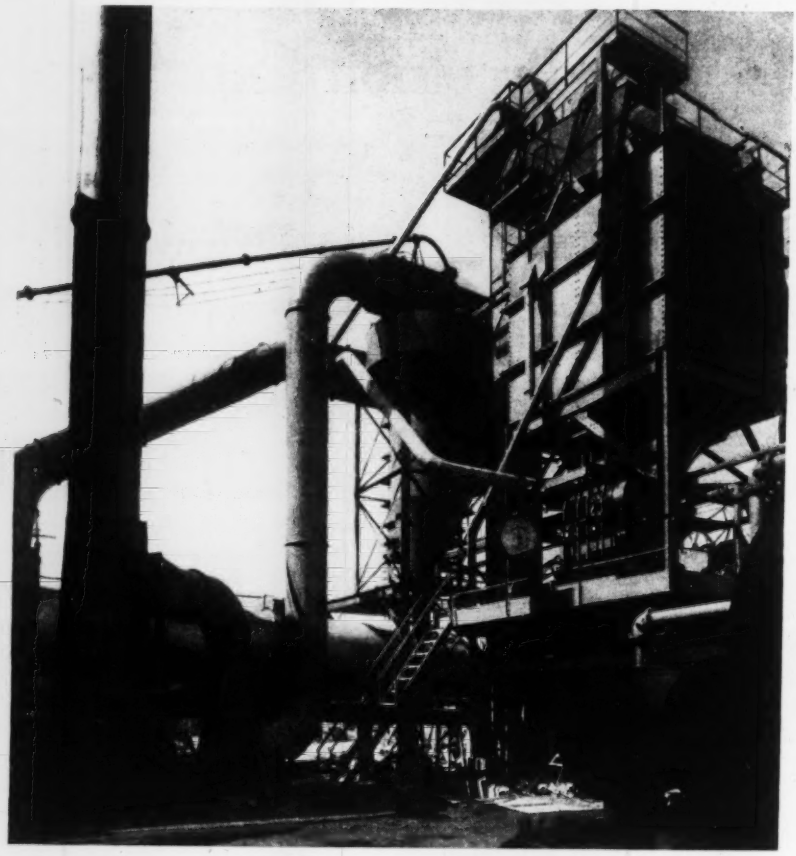


Fig. 1. Dust control is emphasized in the new city asphalt plant for Detroit, Mich., this view during construction shows the dust collecting system and mixer platform.

leaving the drier is maintained practically constant by a thermostatic control especially designed for this purpose. This control is experimental at present and is not a part of the plant assembly but was installed by its designer at his own expense in order to obtain data as to its efficiency. To date the apparatus is functioning very accurately. The sensitive element of the thermostat is an alloy tube about 4 ft. long located directly in the heaviest part of the flow from the drier chute. The expansion of the tube, due to change in temperature, operates a pilot air valve which in turn controls the steam atomizing-type oil burners. Both oil and steam are controlled automatically to obtain the best combustion for all sizes of flame, and by linking the steam and oil valves together in proper ratio the flame is equally stable at low and high fires.

Three indicator lights are installed at a conspicuous point to show whether the desired temperature is being obtained. When either the high or low light glows, it calls for attention on the part of the drum fireman. The cause may be too heavy or too light feed to drier or trouble with oil to burners.

Previous to installation of the automatic control, the temperature of the material in the drier chute was found to vary more than 100 deg. F. from the predetermined point. It has also been found that a single thermo-couple point may show a temperature quite different from the average of the stream of material flowing over it. The sensitive element of this thermostat, however, because of its large surface and length, averages and integrates the temperature of the material and consequently produces a fly-wheel effect. The thermostat unit is also provided with an indicator which points the average temperature of the stream of material. Due to this automatic control of the burners and the warning given by the lights, an aggregate temperature within 15-deg. limits has been maintained for hours during routine operation. Also, as a consequence of keeping proper combustion under all conditions, the oil consumption is kept within a few per cent of the calculated minimum. All fuel-oil lines are metered and a close check on fuel is maintained.

In conjunction with the automatic control on the drier burners, there are three thermocouples, one located in the drier chute, one in the sand bin and one in the stone bin, all of which are connected to an indicating pyrometer located at the front end of the combustion chamber for use of the drum fireman. A separate line also runs to a recording pyrometer located in the superintendent's office in the administration building, which records the temperature of material passing out of the drier chute and in the hot sand bin at all times. By the close control of aggregates entering into the manufacture of the paving mixtures, including the mineral filler which is conveyed for a distance of 25 ft. through a 9-in. steam-jacketed pipe, it is unnecessary constantly to take the temperature of the final mixtures.

Safety features

The hot elevator which is 65 ft. high, consists of 127 buckets each capable of carrying 30 lb. of aggregate. A very heavy single link chain carries the buckets, but due to the height of the elevator and weight carried under full production, two flexible ⅜-in cables were installed, attached to each bucket by U-bolts. These cables run free over the top and bottom shaft and in case of chain breakage would prevent the loaded buckets from crashing to the bottom of the elevator pit.

Another feature in connection with the elevator is a clutch-brake on the motor shaft which drives the elevator and prevents the motor from turning backwards in case the elevator stops while the buckets are loaded. The entire elevator is enclosed in a dust-tight housing.

The hot elevator carries the dried and heated aggregates into an enclosed 4-deck vibrating screen, 4 x 8 ft. in size, from where the screened material is discharged into the hot-aggregate bin of 100 tons capacity with four compartments.

The twin pug-mill mixer will mix a 1,000-lb. batch of any type bituminous mixture; is fully enclosed, and is steam-jacketed. The mixer tips are of the reversible and adjustable type and are arranged to give the around-the-box mix, which seems to give a more uniform mix than the toss type. The shaft revolves about 55 r.p.m.

The mixer-gate is heated, a feature quite necessary in Detroit because of the amount of emergency work in cold weather. The aggregate weigh-box is so arranged on rollers and track that the weigh-box and asphalt can be detached and rolled back out of the way when it is necessary to make repairs on the mixer box. The scales are of the springless dial type, the asphalt scale being connected with a solenoid switch automatically cuts off the asphalt-cement flow when proper scale weight is reached. The asphalt bucket itself is of the stationary type fully steam-jacketed, with heated discharge valve—the bucket and valve being seven-eighths the length of the mixer box.

The time of mixing is controlled by a time lock, equipped with a clutch whereby the time setting can be quickly altered without opening the case when changing from binder to topping.

Dust collection

The amount of dust by weight fed to the aggregate weigh box is controlled by an electric switch located just above the mixer box which also starts the dust conveyor motor. The dust collecting system has pipe ducts leading from all points where dust is prominent. The collected dust is transferred mechanically to a small bin, the bottom of which is level with the aggregate weigh box. From there it is passed through a screw conveyor to the aggregate weigh box as required. This is necessary because of the irregular changing over from binder to topping, which happens many times a day. By having a separate bin, it is possible to control absolutely the amount of fine material from the collector and weigh it for each batch, resulting in uniform sheet asphalt mixtures no matter how much dust is being collected and passed into the separate bin.

Electric motors furnish the operating power, each unit such as cold elevator, drier, hot elevator, screen and mixer being driven by a separate motor. However, the motors are interlocked so that in case any single motor should cut-out for any reason, the entire system automatically stops. Also, it is compulsory to start the screen and hot elevator motor before the drier motor can be started. All bearings throughout the plant are of the anti-friction self-aligning type.

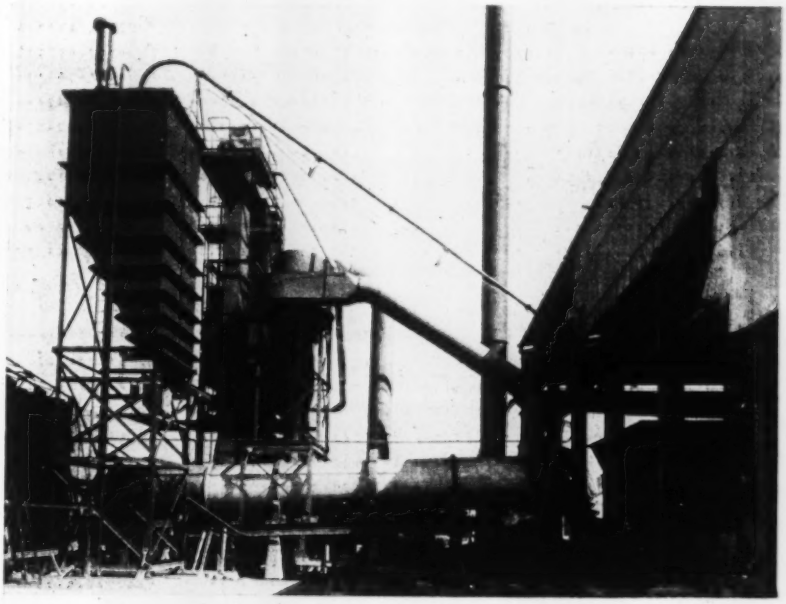


Fig.2. Aggregate heating at the new Detroit asphalt plant is characterized by precise temperature control.

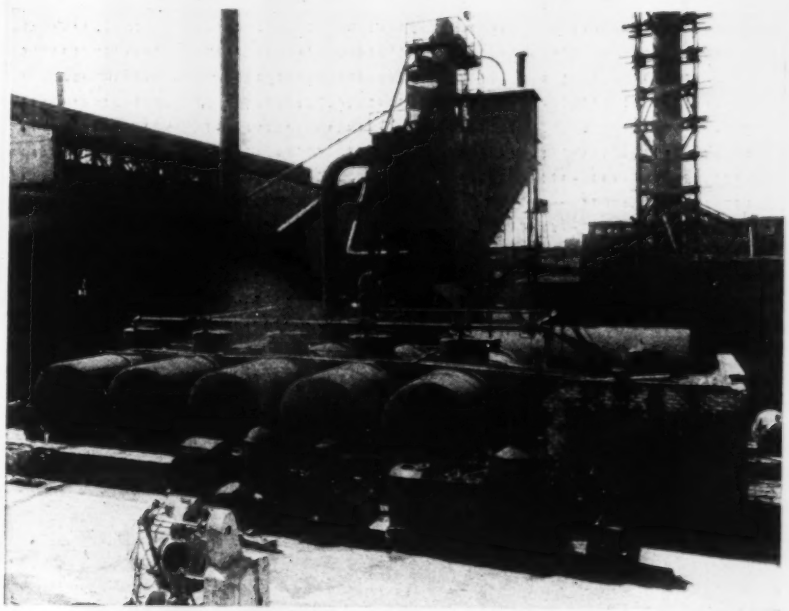


Fig. 3. Asphalt storage at the Detroit city plant provides for the use of eight kinds and their use separately or in any combination.

Steam is furnished by two 150 hp. boilers, which supply the oil burners, asphalt lines and pumps and heat the office, blacksmith shops, machine shops, roller repair shops and various other buildings.

Compressed air is supplied by two large stationary compressors and is utilized in conjunction with the dust unloading system, emergency oil burners, laboratory testing and in the various repair shops.

The unit as described and which

is rated very highly by contractors and city officials due to its efficiency and flexibility is capable of turning out about 80 tons of sheet asphalt mixture per hour, but to date has not been required to operate to capacity except for short periods.

During the 1936 season (May 1 to Dec. 1) the plant working on a 5-day-week basis (40 hr.) turned out 55,000 tons of sheet asphalt mixture (binder and topping), with a labor operating cost of $0.39 per ton of mixture. The plant maintenance cost for the same period, practically all of which was for the replacement of wearing parts such as mixer liner, mixer tips and screens, was $0.26 per ton of mixture, and fuel oil for drying the aggregate amounted to $0.11 per ton.

The plant was built and erected by Hetherington & Berner, Inc., under the direction of the city of Detroit, of which Lawrence G. Lenhardt is the commissioner of public works. The work was supervised by Clarence A. Proctor, engineer of asphalt construction and Jan Schmedding, engineer of street maintenance and construction, assisted by Charles L. Shattuck, assistant chemical engineer, and James L. Flynn, plant foreman.

Straitjacketing Chlorine Tanks When Leaks Develop

Immersion of ton containers in tank of sodium hydroxide solution, which absorbs the gas, proved feasible by experiments conducted at Chicago

THE ADVENT of ton containers for transporting liquid chlorine brought with it the problem of caring for them should any defect or accident cause leaks not readily repaired. Immersion of the container in a solution of caustic soda to absorb the escaping chlorine has long been proposed. Recently, experiments to determine the effectiveness of this solution subjected to high rates of escaping chlorine were made at the Cermak Pumping Station in Chicago, using full size equipment.

Preliminary laboratory tests made in 1932 served as the basis for designing a large steel caustic soda tank. Originally it was the intention to deposit leaking tanks in a pit located in a separate building outside of the pumping station. It was proposed to flood this pit with enough 20 per cent caustic soda solution to absorb completely 2,000 lb. of chlorine. This plan was abandoned because of the high cost of installation, the depreciation and interest charges of which would more than offset the savings due to the lower cost of chlorine purchased in ton containers. The laboratory tests with 1, 2, 3 and 4 ft. submergence however showed that no chlorine was given off until all of the theoretical chlorine-combining capacity of the soda solution was used.

In designing the immersion tanks for the Cermak Station and the Dunne Crib it was assumed that sufficient caustic solution would be supplied to absorb 2,000 lb. of chlorine plus 50 per cent excess caustic to serve as a safety factor. Thus a ton of chlorine would satisfy two-thirds of the chlorine-combining capacity of the caustic solution.

The solution tank as built is 10 ft. 3 in. long, 4 ft. 10½ in. wide and 6 ft. 6½ in. deep. It is made of ⅜-in. steel plates welded together. To reduce the hazards of spattering the solution is covered with a layer of oil, the surface of which is 1½ ft. below the rim of the tank. Arrangements for the tests were simple. Two full cylinders were connected to a common header and a ¾-in. pipe that terminated 37¾ in. below the surface of the caustic solution, 14 in. from the north side and 22 in. above the bottom; this arrangement simulates in submergence and distance from the tank sides a blow-out valve or plug in the end of the cylinder.

The first test was made with all valves wide open giving the maximum flow of gaseous chlorine possible. The maximum rate of 350 lb. per hr. could not be maintained because of frosting, and the rate dropped to 150 lb. per hr. after about 630 lb. had been absorbed. Not the slightest trace of free chlorine was observed over the surface at the nozzle position which indicates that an ordinary or extraordinary gas leak can easily be absorbed once it is submerged about 3 ft. under a 20 per cent caustic soda solution.

The second test was with liquid chlorine, the cylinders being allowed to "warm up." A rate of 700 lb. per hr. was reached within an hour. This rate was increased, finally reaching 1,000 lb. for a short time near the close of the test, 2¼ hours after starting. The average rate of absorption was 600 lb. per hr. At no time was there the slightest trace of chlorine observed above the surface of the soda solution.

Temperatures rose on a straight line to 40.5 deg. C. essentially checking the earlier laboratory tests of 35 to 37 deg. C. at two-thirds saturation.

Tank vibration excessive

During this test, and especially at high feed rates, heavy vibrations were set up which became so severe at times that they were considered dangerous to structural stability if long continued. The tank therefore, will be equipped with stiffeners.

The ½-in. layer of oil was effective in stopping spattering and although it had completely emulsified at the end of the test to form a dense froth, it served its purpose.

Tests of gas masks to learn their safe limits are now under way since if masks are unsafe in an intensely chlorinated atmosphere and fail to protect operators handling a defective cylinder the caustic tank is useless.

The tests were carried out under the general direction of Loran D. Gayton, city engineer, by Paul Lippert, engineer of pumping station efficiency and A. E. Gorman, engineer of water purification.

New Record in Pouring Concrete

Recent progress at Grand Coulee Dam completes preliminary work and prepares for concrete placing schedule of 440,000 cu. yd. per month

ABOUT HALF of the concrete yardage in the present or "foundation" contract at Grand Coulee Dam had been poured by the middle of May. In the remainder of the job, largely a manufacturing enterprise, attention will be focused on methods and equipment that can speed the rate at which concrete can be placed. Barring accidents, work will proceed on schedule throughout the summer high water period and all but some 30,000 cu. yd. of the concrete in the present 4,500,000 cu.-yd. contract will be in place November 1. Before that date it is expected that the next ensuing contract will be let. In a recent issue (*ENR* July 1, p. 13) was published an account of the methods that successfully combatted the serious inflow into the east cofferdam; in the following are outlined experiences of the contractors in preparing the east half of the river bottom for concrete and tuning up equipment for the record-breaking concrete placement program that is to complete the initial stage.

Of the original $63,000,000 made available for this project, about $37,000,000 has been allocated to the contract with the Mason-Walsh-Atkinson-Kier Company. Almost all of the remainder has been spent on or allocated to preliminary work, excavation, necessary structures,

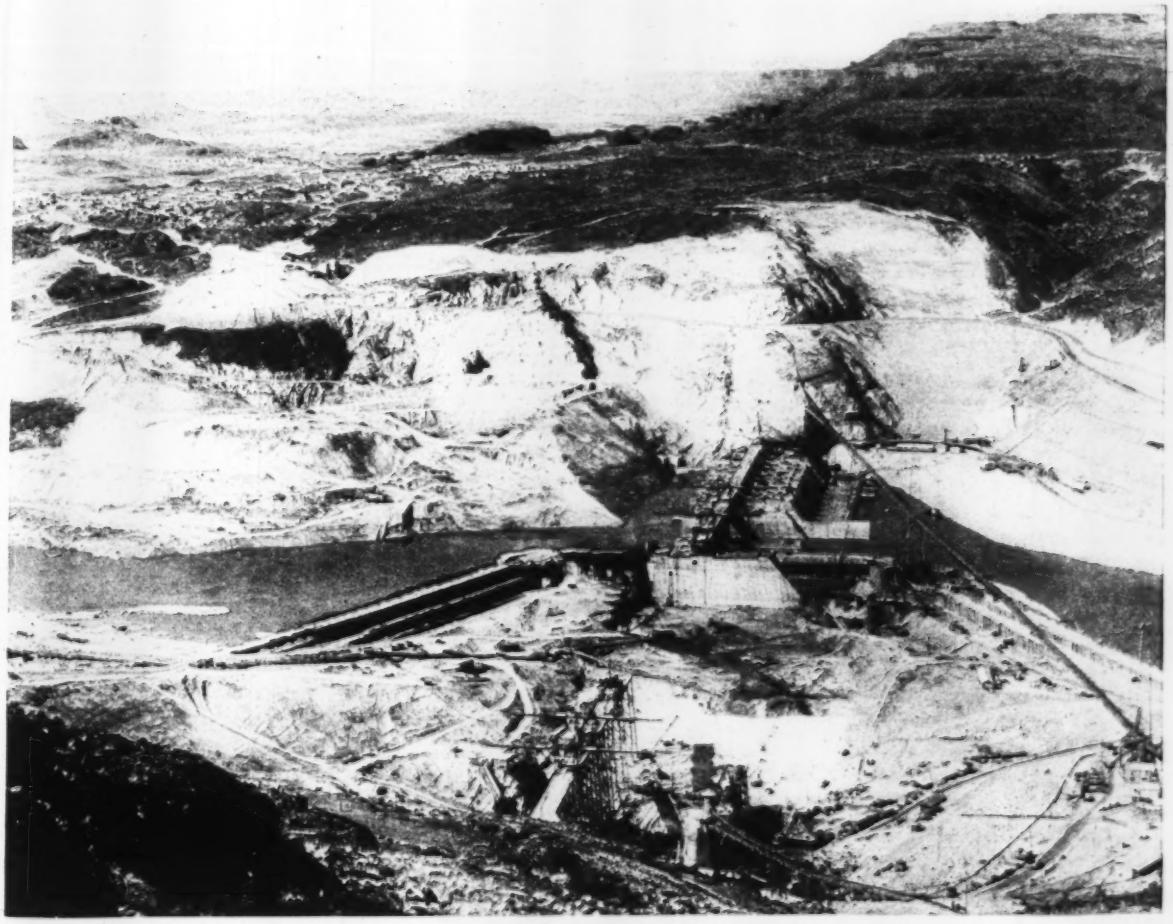


Fig. 1. Concrete for Grand Coulee dam is delivered by trains operating on both high and low trestles along the axis of the dam. Long-arm gantry cranes on the trestle swing the buckets to place in the dam. In the foreground is the construction trestle for the east end being built out into the east cofferdam. Beyond is the nearly completed west end of the base section of the dam. At the top of the picture is the upper end of Grand Coulee, the valley in which irrigation water is to be stored after being pumped from the river.

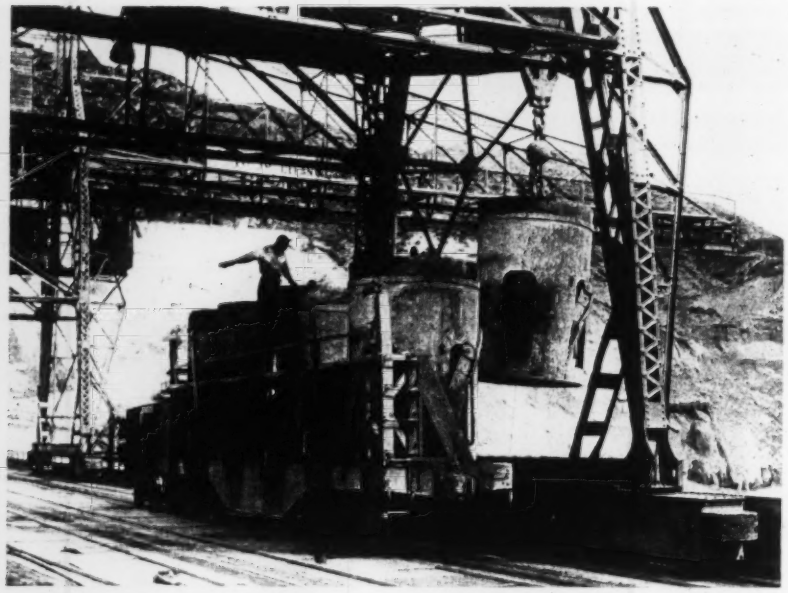


Fig. 2. Concrete buckets on the construction trestle being picked up by the gantry crane for delivery to the dam below.

building the permanent camp on the west side of the river together with utilities, transportation facilities and incidental work.

There has been much speculation as to whether the present contractor will be the successful bidder for the next concreting contract. A factor in this question is that other bidders are encouraged by a clause in the present contract which provides that the government holds an option to buy for $100,000 all equipment installed and used by the present contractor in concreting operations. The contractor's camp, known as Mason City, with all structures and utilities, may be taken over on payment of $25,000; Also the transmission line and substation for $25,000. Presumably these facilities will be made available to the next contractor.

River bottom "in the dry"

Prior to excavation of the damsite, a total of 45,000 lin. ft. of core drill holes had been put down to test the nature of the over-burden and the quality of the rock beneath. The core drilling included some 200 holes with an average depth of 225 ft., and some that were put down as far as 800 ft. Although this amount of drilling gave assurance of quality in the underlying material, the holes were not close enough together to give an adequate indication of bedrock contour and in the cleanup of the foundation more irregularity was encountered than the drill holes indicated.

After the over-burden had been removed by conveyor belts and motor trucks, final cleanup of the bedrock was begun and all seams and pockets were cut out to give adequate bearing of concrete on granite. With a base width of 500 ft. and a length of about 4,000 ft., the area of the concrete-granite contact, even assuming abutment areas to be measured in horizontal projection, totaled about 2,000,000 sq. ft. For this 50 acres of granite area the preparation of the surface, after excavation was completed was an extremely expensive job because of the amount of handwork with pick or bar. This operation, rather accurately described as "manicuring", cost about 75 cents per sq. ft.,—a total of $1,500,000 for the 2,000,000 sq. ft.

Completion of the high construction trestle across the east cofferdam was delayed by bedrock cleanup that had to be finished before trestle footings could be put in. After this trestle was in service concrete from the west mix plant could be delivered throughout the length of the east cofferdam. The east mix plant delivers directly to cars on either the high or the low trestle.

With the purpose of relieving the large cranes from minor service operations, two steam whirleys have been converted to auxiliary service in the cofferdam and have been provided with gantries. These machines are operated by electric hoists and can handle 2-cu. yd. concrete buckets; they will be used for placing form panels and for otherwise relieving the eight large cranes which thus will be available for delivering the 4-cu.yd. concrete buckets exclusively. To speed up concrete delivery where it would provide protection behind the cofferdam cell clusters (where serious settlement and collapse occurred in March) a large steam whirley was set up in the west end of the cofferdam. This machine, operating in the zone that later would be served by the low trestle, speeded up the operation of thickening the river side of the cofferdam, supplementing concrete delivery via the high trestle from the west side and making it possible to pour promptly the full length of block 41, the block on the river side of the east cofferdam.

Maximum rate and effectiveness of placing concrete was not attained until both high and low trestles were completed and continuous capacity runs from both mixer plants could be delivered anywhere on the dam. The experience and training of men in concreting the west half of the job resulted in notable improvement in the efficiency with which concrete was placed in the east cofferdam. For a while the best records were on the order of 8,000 cu. yd. per day from the one mixer plant operating with six crews, i.e., 55 cu. yd. per crew hour. Later, corresponding figures were 7,500 cu. yd. per day with four crews; i.e., 78 cu. yd. per crew hour. This increased efficiency is accredited to the better trained personnel and the more rigid schedule. With the complete mixing cycle timed at 2¼ minutes (*ENR* Oct. 15, 1936, p. 546) it is expected that concrete will be delivered at the average rate of 1 cu. yd. every 5 seconds. The scheduled delivery rates for July, August and September is for 440,000 cu. yd. of concrete per month. If this program is maintained the October schedule will slow down toward completion of the work and by Nov. 1 only about 80,000 cu. yd. will remain to complete the initial contract.

Cleanup of foundation rock has been progressing rapidly as some 5,000 cu. yd. of granite per day has been drilled, broken up by blasting

and removed from the cofferdam. This yardage was taken out piecemeal from the surface, a pocket here and a shallow layer there.

Changes in handling materials

The cement delivery system was designed to supply cement for a concrete production of 12,000 cu. yd. daily. When deliveries of 15,000 cu. yd. per day were scheduled, additional cement delivery capacity became necessary and another cement silo with its blending equipment was put in. Addition of this unit brought cement storage to a total of 55,000 bbl. The single 11-in. cement delivery line extending from the cement storage to the west mix and then to the east mix plant was supplemented by an additional 9-in. line from cement storage to west mix plant. This line is served by an additional cement delivery pump with a capacity of 600 bbl. per hour. The pump previously installed (brought to this job from Boulder Dam) can deliver about 400 bbl. per hour to the east mix plant.

With the second mixer plant increasing the demand for aggregate, the sand storage capacity was not adequate to allow sufficient time for drainage. Three grades of sand come from the classifier soaking wet and with two mixer plants operating, sand did not remain in storage long enough to drain to a uniform water content. Provision of space and equipment for stock piles which quadruple the sand storage capacity, has eliminated this difficulty.

Thus far, only 38 to 40 per cent of the pit run has been wasted in the form of excess fines instead of the 55 per cent originally estimated. Indications are that a higher percentage of waste will be encountered in the lower levels of the pit. A new jaw-crusher has been installed for reducing the 16-in. reject and addition of a second gyratory crusher has provided reserve capacity to safeguard against a breakdown in this part of the plant.

The ratio of concrete yardage to pit production now is about 1 to 1.95, thus the pile of waste fines is increasing at about the same rate as yardage in the dam. As of the middle of May, fines in the waste pile approximated 2,500,000 cu. yd.

With yardage in the east cofferdam increasing rapidly, a new pumping plant for concrete cooling has been required. Horizontal grids of cooling pipes are laid on top of each 5-ft. lift of concrete. These are connected to headers leading into supply mains through which river water is circulated. On the up-stream side of the cofferdam four high pressure centrifugal pumps are installed on a barge moored close to the cofferdam wall. A 11-in. welded steel pipe over the top of the cofferdam and leading down to the concrete is connected to the barge by a rubber hose to take care of river stage fluctuations. Near the low point of the system inside the cofferdam, booster pumps are installed which force the cooling water back over the cofferdam through a 16-in. return line. The river water goes into the circulating system at a temperature of 50 deg. F.; in the course of the 10 to 15 minute period of circulation, it picks up 16 deg. F. at which temperature it is discharged again into the river.

The Grand Coulee Dam contract is being carried out for the U. S. Bureau of Reclamation, Frank A. Banks, project engineer, by the Mason-Walsh-Atkinson-Kier Company, T. J. Walsh, president, C. D. Riddle, chief engineer and M. H. Slocum, general superintendent.

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Removing Tracks From City Streets

STREETCAR TRACKS left by abandoned trolley lines are a source of annoyance to cities whose problem it is to get rid of them. In many places throughout the country the tracks may be found lying useless in streets where buses now rumble, frequently because there were no contracts to hold the traction company responsible for their removal when the shift from trollies to buses was made.

A survey of action taken by 37 American cities on this problem was issued recently jointly by American Municipal Association, the American Public Works Association and the International City Managers' Association, from information gathered under the direction of Joseph E. English, department of public works and service, and Thomas J. Walsh, administrative assistant to the city manager, Trenton, N. J.

Although in some cases, stipulations in traction franchises specify the traction company's duty to restore the pavement to conformity with the remaining street surface when tracks are abandoned, it is often difficult to force the company, especially if it is in receivership, to carry out the terms of the contract, says the pamphlet.

Among plans followed by cities in removing the abandoned tracks are these:

(1) The company conveys title to the tracks to the city, in return for which the city releases the company from any further obligations; under this arrangement the city paves the street, at the same time removing the tracks for salvage.

(2) The company makes a cash payment to the city to discharge any obligations on rail removal.

(3) In cases where the city is not ready to repave, the company is permitted to cover the rails with asphalt, concrete or other material, leaving them buried in the street until the entire thoroughfare is repaved.

Fifteen and twenty years ago, before the days of bus competition, the report points out, it was almost universal practice to require the street car company, either by state law or by franchise, to pave and maintain the street area between the tracks and for a specified distance on either side. In the 1920's some state, including Connecticut, Indiana, Iowa, Massachusetts, Montana, New Hampshire, Rhode Island and Utah, granted some measure of legislative relief to street railway companies, thus making more serious for cities the question of track removal and repaving.

Many cities have made car-track removal a relief project, the survey shows, salvaged the rails, getting from $9.35 to $12.75 a ton for the scrap iron. In Wichita, the traction company paid the city's share of $75,000 on the WPA project for repaving after rails had been removed. Erie got $50,000 from the traction company for the work of removing abandoned tracks.

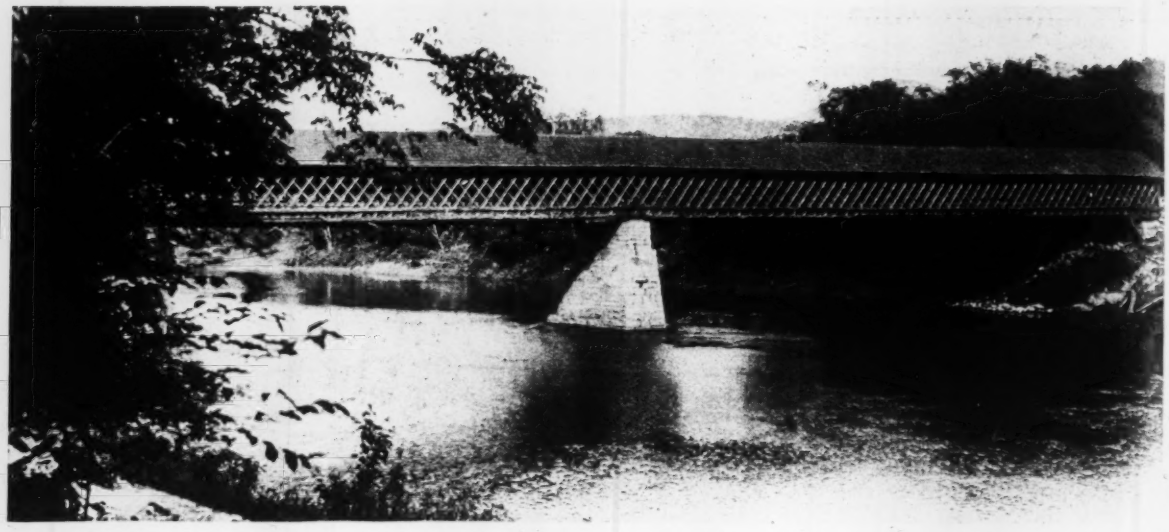

FIG. 1. BATTERED BUT UNBOWED BY FLOOD THIS ORFORD, N. H., LANDMARK NOW YIELDS TO A 425-FT. STEEL ARCH.

Bridge Engineer's Odyssey

by WALDO G. BOWMAN

Associate Editor, Engineering News-Record

The traveler in the river valleys of New England encounters bridge construction at every turn and interesting evidence of flood damage and repair

A PERFECT SET-UP for any bridge engineer who wants to take a busman's holiday exists in New England. There, as a result of the March, 1936 floods, bridge building and repair are in full swing on a scale that, so far as number of projects is concerned, taxes the imagination. New structures and repair jobs large enough to let to contract total 138; two dozen of these are of considerable size. Smaller structures built or reconstructed by force account swell the total to over 700 bridges that may be seen in various stages of completion. And without excessive travel, the visitor can find among these many structures a number which have technical interest in special degree.

A New England bridge inspection trip might begin on the Connecticut River, which can be followed north to the White Mountains in New Hampshire. Then, a portage east over the watershed brings one to the headwaters of the Merrimack River. Following this stream south to its mouth in Massachusetts, sightseeing operations can be transferred to Maine where four large rivers the Saco, Androscoggin, Kennebec and Penobscot, provide varying scenes of construction activity. The map (Fig. 2) indicates, in addition to the state capitals, the points of principal flood bridge reconstruction. Nowhere else in the country can such a brief trip reveal so much evidence of the bridge building art. In this article the Connecticut Valley structures will be visited. Next week "flood bridge" work on the Merrimack and the rivers of Maine will be described.

Along a 160-mile front

The Connecticut River is about 300 miles long, and in the south 160 miles of this length nine new bridges and eight repair jobs are in various stages of completion. Not since the pioneer timber bridge builders of a half-century or more ago bridged this stream with ax, hammer and saw has so much bridge building activity been seen in the valley.

Traveling north, the first new bridge is encountered at Middletown, Conn.—a high-level structure of two 600-ft. tied-arch spans with long approaches. Although not strictly a "flood" bridge, it will replace an old five-span truss structure that would not stand many more such batterings as it received in the 1936 flood. The west steel girder approach is up, and steel erection is under way on the tied arches. Except for two of the main piers, the foundations of this bridge were put down as rotating steel caissons.

No Connecticut River bridges were lost or badly damaged in the state of Connecticut, but Massachusetts presents a more serious picture. At Holyoke a new concrete floor furnishes the visible evidence of a flood repair job on ten 160-ft. wrought iron double-intersection truss spans that were built 37 years ago.

Much more work, however, went into this bridge, whose bottom chord was 4 ft. under water. While the stone masonry foundations were not damaged, the lower chord in the seven west spans was bent by the pounding ice, all sway bracing was torn out, and several of the spans were pushed sideways on the expansion rollers from 1 to 5 in. The roadway of wood block on planks was largely washed out, but no damage was done to the floorbeams, stringers or trusses above the chords.

The chord, consisting of two built-up channel members joined by batten plates, was straightened by inserting small jacks between the plates, sometimes using long timbers to distribute the jacking load. In some locations it was necessary to heat the plates and angles with blow torches and then straighten them with a sledge. Since the chords could not always be brought to perfect straightness, side reinforcing plates were welded on them at various locations. Several new pieces of chord had to be inserted, and this was done with the aid of cables, temporarily serving as chords.

Up the river at Northampton plans are under way for a new deck truss structure consisting of a 203-ft. simple span at either end and a 260-296-260-ft. continuous unit in the center. This structure, to be known as the Calvin Coolidge Memorial Bridge, is not in the flood replacement program but is badly needed since the existing bridge, although it did not go out in the flood, is light and narrow. The new bridge will have a 40-ft. roadway.

At Sunderland is encountered the first real victim of the flood. Here, an old five-span steel truss structure broke off the top of the masonry piers when the water got above the floor. The rest of the old piers remained intact and, after being supplied with new concrete caps, they are serving as supports for a temporary trestle bridge while the new bridge is being built 200 ft. downstream on a much better alignment. The temporary bridge provides a 20-ft. timber roadway on I-beam stringers set on top of bents of 12-in. H-section piles, five bents between each of the old foundations. Founded in 80 ft. of mud, the piles had to have 10x10-in. timbers bolted to them to give increased friction area.

The new bridge will consist of six simple spans of 150 ft. each made up of four lines of deck trusses. Inasmuch as the foundation material is so poor, wood piles 75 to 110 ft. long are being driven to firm sand and gravel. Under the abutments composite piles are being used. The new roadway will be 40 ft. wide and the noses of piers will be equipped with stone ice breakers. One of the most interesting details of the new bridge will be the tie-downs (Fig. 3) used to hold the superstructure on its foundations. No chances are being taken that the new bridge will topple over as the old one did.

Story of five bridges

North of Sunderland is the village of Turners Falls and the story of five bridges, old and new. Situated in a bend of the river so abrupt that it approaches the shape of a loop, Turners Falls was originally served by three famous old bridges. A mile south of town on the road to Greenfield was a covered timber bridge of five spans (about 165 ft. each) that had been a landmark since 1869 when it was built to carry a single track railroad on top and a roadway beneath. An interesting combination of timber trusses and laminated arches, it proved surprisingly sturdy, and toppled over only when its firmly embedded anchor bolts pulled off the tops of the stone piers. Next upstream was a light iron suspension bridge of 1890 vintage, and around the bend and above the dam was a bridge of duplicate design. Both of these suspension bridges escaped the flood waters, but old age could not be avoided. The south bridge, which for some years had been posted for only two cars at a time, was inadequate for the increased traffic diverted to

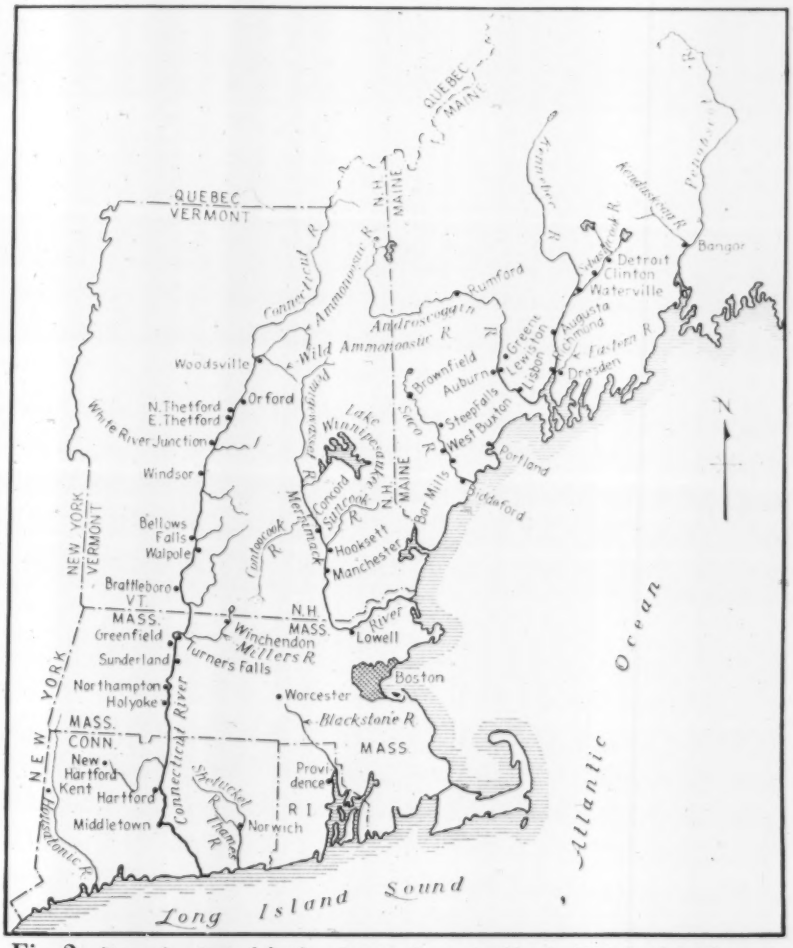

Fig. 2. Sites of principal bridge damage from the March, 1936 flood in the main stream valleys of New England.

it when the covered bridge went out, and has been taken down and replaced by what is termed a temporary bridge (Fig. 4), while the north bridge will end its useful life when a modern continuous truss structure, now under way on a new location aligning with the main street of the village, is completed. Turners Falls thus get two new bridges for an old covered bridge—a good trade.

Both of the new bridges present points of technical interest. The continuous truss bridge, known as the Gill-Montague Bridge, because of the townships it connects, will be a deck truss of five spans consisting of a 400-450-400-ft. continuous center unit flanked by a 150-ft. span on one end and a 225-ft. span on the other. With its center pier on an outcropping of grotesquely laminated and folded rock just below the foaming water that comes over the dam, the bridge will have a picturesque setting. The 1936 high water level at this location was 12 ft. above the previous record stage in 1927, but the new bridge has been designed to clear the 1936 flood level by 8 or 9 ft.

The bridge which replaces the old suspension bridge is completed and its interesting details thus are visible (Fig. 4). It is called a temporary bridge because Turners Falls residents hope that it can be replaced by a single-span structure. It may indeed prove to be temporary if the record flood is repeated soon, for it has five piers in the gorge through which the river flows. But it was built nevertheless to provide a sturdy bridge at a reasonable cost. These piers represent the most interesting feature of the bridge. They are necessarily tall, about 48 ft., and since they rest on ledge in a narrow confined canyon it was necessary to anchor them securely and was advisable to make them heavy but slender. Accordingly, they were made 6 ft. wide at the base and 3 ft. at the top, and forty 1¼-in. dowels extending 4 ft. into the ledge served as anchors.

The 20-ft. timber deck of the bridge is carried on seven lines of 36-in. 230-lb. girder beams 4 ft. apart joined by five 18-in. I-beam cross members in each 74-ft. span.

Moving north into New Hampshire one finds the flood toll on the Connecticut River even greater. Whereas Connecticut lost no bridges over this stream and Massachusetts lost only two, in New Hampshire five crossings were washed away or damaged so badly that new bridges are required. In addition, the damage to two other bridges was so severe as to require unusual repair operations, one on a superstructure, the other on foundations. Nine bridging operations are thus to be seen along a 90-mile length of the river in New Hampshire. It is to be noted that, whereas the approaches to most of these bridges are in Vermont, the bridges themselves are in New Hampshire, since the state line is on the west bank.

The first bridge visited as one travels northward is the famous old Brattleboro suspension bridge of 350-ft. span, built in 1886. Or rather the site is visited, because ice on the crest of the flood toppled the stone pier under the east tower, converting the old structure into a mass of wreckage. (As a sidelight on the failure, the old cables were salvaged and trucked across the state to Manchester, and are now supporting a temporary footbridge while that city builds a new highway bridge nearby.) The Brattleboro site is now the scene of steel erection activity on a new 425-ft. span arch just upstream from the old bridge.

Most interesting operation to date has been the placing of steel falsework bents on steep sloping ledge in 50 ft. of water near the west bank. By equipping the ends of the steel H-piles with silicon steel knives and churning these up and down, a foothold was gained which was effective enough to resist the high water that occurred in May of this year. Likewise interesting but not so effective was the method used to hold timber bents of a temporary highway trestle on the old suspension bridge align-

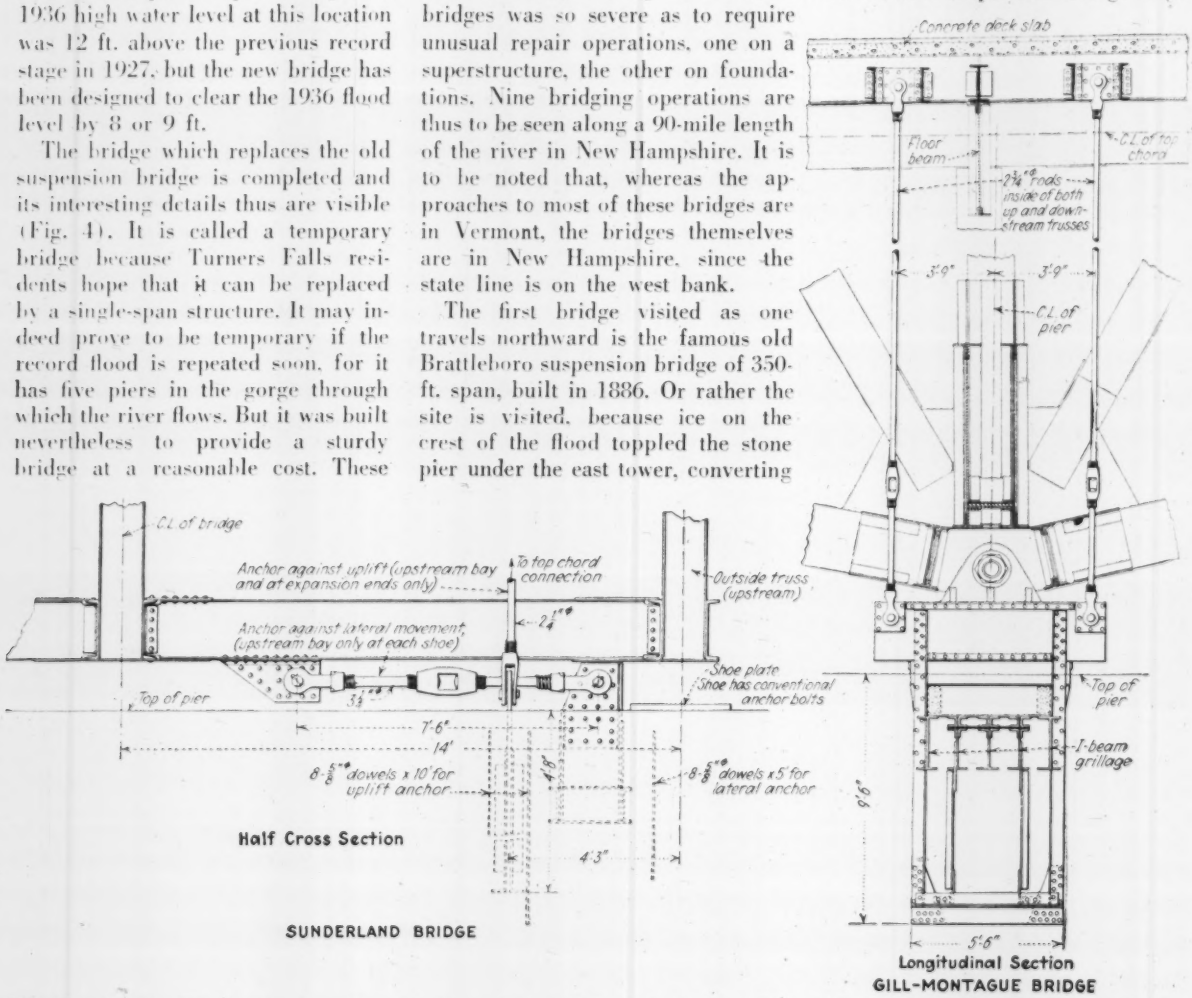

Fig. 3. Details of high-strength anchor details used on two new Connecticut River bridges in Massachusetts to resist tipping or sliding of the spans under action of flood waters and debris.

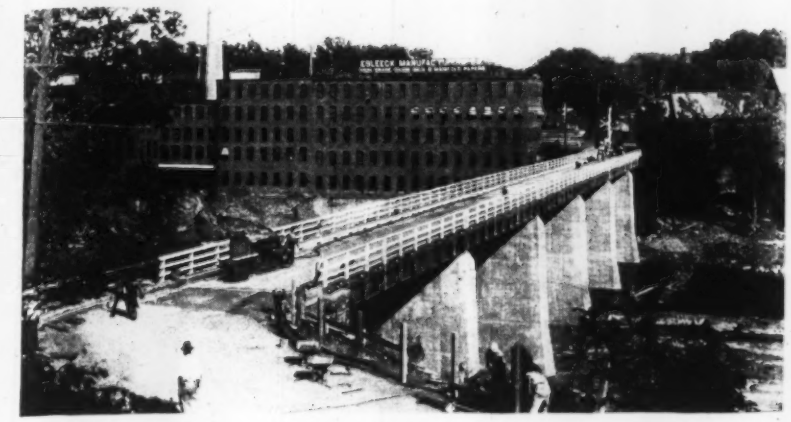

Fig. 4. At Turners Falls, Mass., this temporary bridge is interesting because of its tall, narrow piers that are doweled deeply into the stream bed rock.

ment on this ledge. Holes about 3 ft. deep were blasted out of the ledge, dowels were set in the holes, the piles of the bents lowered over them, and the holes filled with sacked concrete which was carried up about 3 ft. around the pile base. Although these bents resisted the spring ice several of them were taken out by the May high water, probably more because of the light weight of the bridge than of shortcomings in the anchor details.

The new arch bridge, on improved alignment, will be above 1927 flood levels but its end pins will be submerged 4 ft. if the 1936 flood is repeated. It will cost about $250,000 and will provide a 24-ft roadway and two 2½-ft. sidewalks suspended from the arch ribs by pin-connected H-section hangers. The floor will be a concrete-filled steel grid. These details and the fact that the west abutment is on ledge rock while the east abutment is on 72 steel H-piles about 30 ft. long constitute the principal features of the new bridge.

Upriver, the next two bridge locations present repair rather than reconstruction. At Walpole, for example, the Connecticut River is crossed by a steel plate-girder bridge of three through spans (136, 158 and 150 ft. long) erected in 1911 on the old stone masonry foundations of an early timber bridge. The two river piers were badly scoured during the flood and, since the superstructure was clearly worth saving, the piers had to be either replaced or repaired. A repair method involving jacketing the piers in concrete was decided upon, which virtually provided new piers since the jacketing alone has adequate strength to carry the bridge.

Since the load capacity of the bridge had been materially increased several years ago when the old deck consisting of the original 10 in. concrete slab and 12 in. of asphaltic concrete added later by town officials was replaced with a concrete-filled steel grid surfaced with asphalt plank, it is now thoroughly adequate for modern traffic.

The job of building these piers was considerably enlivened when it was found that the timber cribs under the old piers were infested with eels, which choked the pump suction to such an extent that an hour or two each day was spent cutting them out. A good many bushels of eels, sealed up inside the pier jacketing, are destined to provide fossil specimens for some future generation.

Three miles north of Walpole is Bellows Falls, where a 540-ft. span spandrel-braced three-hinged arch had a miraculous escape from destruc-

Fig. 5. Removing damaged end panels of 540-ft. arch at Bellows Falls preparatory to extending abutments out to the new end pins. Bottom view shows shortened span functioning temporarily as a tied arch.

tion and furnished a spectacular example of repair. Situated just above a high dam whose construction resulted in submerging the abutment pins, the arch presented a fair target whenever the water level rose in a flood. In March, 1936, with about 25 ft. of the arch at each abutment under water, an ice pack extending entirely across the river moved down against the arch, bending the upstream lower chord as much as 10 in. out of line at each end and buckling much of the end sway bracing into uselessnes.

Fig. 6. Site of the Brattleboro suspension bridge which is being replaced by a 425-ft. steel arch. Earth placed on the deck of the temporary trestle bridge helped it to resist ice floes this spring, but later high water took out some bents resting on ledge rock.

Spectacular repair

Defying theory, the bridge did not collapse, but it was left in such a precarious condition that quick decision on emergency supports and repair methods was necessary. The decision on repair was to remove the damaged ends of the arch, reducing the span to 486 ft., build out the abutments to this point and install new pins. To accomplish this work, a spectacular scheme was developed.

First, timber towers were built under panel point L4 at each end (Fig. 5), and the arch between these supports (about 427 ft. long) converted to a tied type by stretching two 2½-in. diameter cables between the L4 panel points of each arch truss. The cables were stressed with a 10,000 lb. pull by hydraulic jacks. Roller shoes were placed on the timber towers and hydraulic jacks were installed as part of the supports so that any adjustments necessary later could be made.

With the arch thus made safe, the three damaged panels of steel work at the ends were removed, permitting attention to be transferred to the construction of the new abutments. Essentially the problem was to raise the existing abutments and extend them riverward so that the new pins would be 17½ ft. higher and 54 ft. closer together than the old ones. The most economical design, considering the steep slope of the river bottom directly in front of the old abutments, was to construct a pier under the front end of the enlarged abutments, which could then be built to span between these piers and the old abutments. To insure that the arch thrust would be properly distributed through the new abutments to the new pier and the old abutments, a triangular steel frame was installed which carried the new arch pin at its apex while its legs rest respectively on the old pin bearings and on the new piers. The new pins are in the plane of old truss members L2 U2. Thus while three panels of damaged steel were removed at each end, one of these panels was replaced with new steel, so that the net shortening of the arch is 2 panels at each end or 54 ft. With the arch thrust transferred to the new abutment, the tie cables were removed and the arch again functioned as three-hinged.

Construction of these new arch foundations was not unduly difficult, although the 15 steel H-piles under each new pier had to be driven 100 ft. to hard bearing. At one time during the work the west timber tower supporting the temporarily tied arch was threatened by an ice flow, and all operations were suspended while a fender wall of steel sheet piles was built. The flow broke up before it reached the bridge, however, and the wall was not used. Its cost of $6,500, although a necessary expenditure, increased the cost of the repair work (all done by force account) to $120,000, including the replacement of the old timber floor with a concrete-filled steel grid deck. Since the low contract bid received for repairing the arch (without the new floor) was $120,000, the state highway department, which rejected the bid in favor of force account, believes that its decision was justified.

On leaving Bellows Falls for a trip up the New Hampshire shore of the river to the next new bridge operation at White River Junction, the traveler crosses an open-spandrel concrete arch over the deep narrow gorge just below the dam. Located above the floodwaters, this bridge was not damaged, although a large block of ledge rock under its east abutment fell away and will have to be replaced with a concrete pillar. The bridge is principally notable as the ancestor of the first bridge across the Connecticut River, built on the same alignment by Enoch Hale in 1785. This early crossing was a timber cantilever of three spans and was in use until 1850, when it was replaced by a covered timber truss that served until the present bridge was built in 1931. Bronze tablets on the present concrete bridge commemorate these famous timber ancestors.

On the way to White River Junction, the old two-span timber toll bridge at Windsor is passed. This venerable structure was so battered with ice that the entire lower chord of the upstream truss had to be replaced, as well as a large number of the lattice web members. It is back in service and as stable as ever.

At White River Junction steel erection is under way on a new bridge of two 150-ft. through-truss spans using the old masonry piers. Since

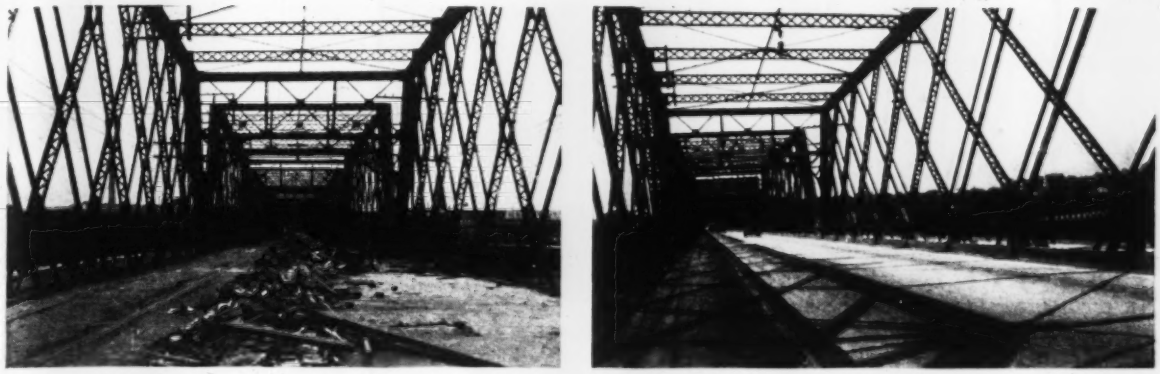

Fig. 7. Before and after repair of Connecticut River bridge at Holyoke, Mass., in which wood block pavement was replaced by a concrete slab and floorbeam hangers were inserted at intersections of truss diagonals.

the new bridge is wider than the old pin-connected truss structure, box-girder pier caps are used, cantilevering over the downstream edge of the piers to support the new trusses.

The next crossing north of White River Junction is the new and artistic deck plate girder at Hanover, undamaged, but beyond it are three bridges in a distance of six miles that are or have been scenes of new construction. At East Thetford steel H-piles are being driven in the bottom of a cofferdam in the center of the river where a new pier will be built for a bridge of two 231-ft. through-truss spans which will replace one of three 125-ft. spans that was washed out. At North Thetford, nearby, one of two 125-ft. spans went out, but since the structure remaining was adequate and safe the washed-out span was merely replaced by a new one.

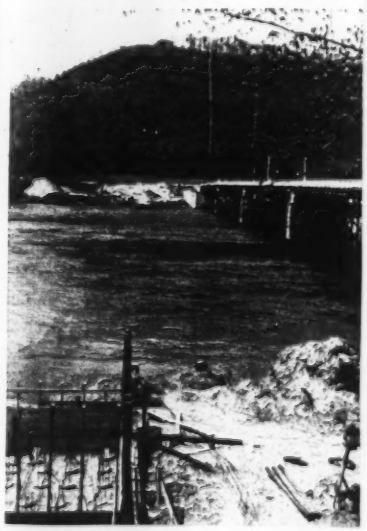

Fig. 8. At Sunderland, Mass. steel pile trestle on old bridge alignment serves traffic while new crossing is built alongside.

The third bridge of this group is at Orford. Situated at the northern end of the line of Connecticut River destruction in New Hampshire, the new bridge under construction here is, by coincidence, a near duplicate of the southernmost bridge, the Brattleboro steel arch. It has the same span, 425 ft., the same 24-ft. concrete-filled-steel-grid roadway, and in arrangement and size of members it is also very similar. It is however, a tied arch instead of two-hinged because the Orford foundation conditions made the latter design too expensive. As it is, 75 to 80 steel H-piles have to be driven at least 30 ft. below streambed to provide a suitable support for each of the Orford foundations.

The old bridge at Orford was a two-span covered bridge (Fig. 1), which like a good many others of its type, was badly battered but did not go out. Faced with the problem of taking it down and salvaging the timber, the engineers adopted the novel expedient of building a fire over the center pier. When the bridge burned in two, dropping the ends into the water, the halves were pulled around on shore. A temporary trestle on the old alignment, maintained with some difficulty because of high water and ice this spring, serves traffic while the new bridge is being built about 100 ft. upstream.

Before leaving the Connecticut River Valley for the trip down the Merrimack, one more bridge demands attention—a 120-ft. truss over the Wild Ammonoosuc River near Woodsville. This aptly-named mountain stream, when in flood rolls hundreds of cubic yards of boulders down to its mouth, and in 1927 this debris tore out every bridge in its path. It was not quite so destructive in 1936 but this new truss span (built after 1927) had one of its abutments and upstream wingwalls undermined, dropping one corner of the bridge nearly 2 ft. and tearing out most of the upper lateral bracing but otherwise not damaging the steel.

The span was jacked up to normal elevation as the first step, and then the old abutment and upstream wing all were torn out. The new abutment sunk 10 ft. and the wingwall 16 ft. below streambed are both founded on steel H-piles. In addition the wingwall was made 20 ft. longer. These extraordinary precautions were held justified as insurance against loss of the span in this location of demonstrated hazard, and they suggest a type of design that may be justified elsewhere.

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Business Census Closes Philadelphia Office

With the completion of its current business census project, covering business operations for the year 1935, the Bureau of Census has closed its temporary branch at 2401 Chestnut St., Philadelphia, and is moving to the Commerce Building in Washington. The census of business received and tabulated a total of 3,000,000 schedules on all phases of business. In addition to preliminary and interim reports on many subjects, there were published in volume form a total of 35 final reports, including three on construction.

A.S.T.M. Convention at New York

Developments in materials research and in specifications and testing standards occupy attention of large attendance at 40th annual meeting

IN CHARACTERISTIC MANNER the annual convention of the American Society for Testing Materials, held in New York City, June 28-July 2, was productive of much new information on the materials of construction. Nineteen meeting sessions and nearly 200 committee meetings were held during the five days. The general news of the convention, covering such items as new officers, committee changes and prize awards, was published last week. This report summarizes, by materials, the significant papers and specification developments that were presented. Steel, cement and concrete were as usual of major interest, but important additions to knowledge were also made in brick, paint, timber, bituminous materials and cast iron.

Steel and wrought iron

Specification developments relating to steel, although numerous, largely concerned pressure vessel materials, and of seven new tentative specifications only one, on weld filler metal, is of interest to the civil engineering field. Drawn with the cooperation of the American Welding Society, this specification provides for seven grades of filler metal classified according to tensile properties, and sets forth test specimen dimensions and methods of preparation. The existing list of specifications for steel suitable for fusion welding was withdrawn as not meeting present requirements.

The most important feature of the steel session was presentation of the final report of the research committee on yield point of structural steel which, since it was appointed in 1926, has reported on five series of tests involving over 1,000 specimens. Among the results and conclusions of the committee, of which Prof. M. O. Withey (Univ. of Wisc.) is chairman, are the following:

1. The yield point in tension is a reliable index of the yield point in compression.

2. It is not possible to predict the yield point from the ultimate strength with accuracy.

3. The range in yield point of different portions of shapes was 29,090 to 38,830 lb. per sq.in., whereas the variation in tensile strength, 52,520 to 62,400 lb. per sq.in., was proportionately much less. In most cases this variation in yield point appeared to be due to differences in cooling and rolling to which the different portions of the shapes were subjected. In the majority of cases the yield points of the light shapes exceeded the yield points of the heavy shapes.

4. Of the four methods used to detect yield point, the multiplying dividers method is slightly more reliable than the drop-of-beam method. The 2-in. strain gage is not quite so satisfactory as the dividers with an 8-in. gage, and scaling is the least satisfactory. All things considered, the drop-of-beam method, being simplest and quickest, is sufficiently reliable.

5. For the ¾-in. round rods of carbon, silicon, and nickel structural steels, raising the free speed of the testing machine head from 0.05 in. per min. to 2 in. per min. increased the average yield point 9 per cent for carbon steel, 7 per cent for nickel steel, and 12 per cent for silicon steel. At a speed of 0.2 in. per min. the yield point by the drop-of-beam averaged 600 to 1000 lb. per sq.in. higher than at a speed of 0.5 in. per min.

6. The effect of speed on yield point was somewhat greater for rectangular specimens cut from structural steel shapes than for the round bars.

7. On the basis of representative specimens, the average yield point for a given shape by mill tests exceeded the corresponding value from cooperating laboratory tests by 3 to 17 per cent; likewise average tensile strengths by mill tests were from 3 to 12 per cent higher. It did not appear that these discrepancies could be due to differences in speed.

The committee recommended that the speed requirement for the determination of the yield point based on the speed of head running free be discarded and that in the vicinity of the yield point the rate of pulling be limited by rates of strain or by rates of stress. Tentatively, for wedge grips and an 8-in. gage length, the suggested maximum limit for the rate of strain in the vicinity of the yield point is 0.0015 in. per in. per min., corresponding to a stress limit of 45,000 lb. per sq.in. per min. It was also recommended that specimens for testing be cut from the following locations: for plates and angles, the intermediate position between edge and center of plate and between toe and heel of angle; for channels and I-beams, the center of the web; and for H-beams and other wide-flange members, the position midway between toe and root of flange.

Papers presented at the steel session included a review of weld metal testing practices by L. J. Larson (A. O. Smith Corp.) and a presentation of a method of locating flaws in steel and of identifying steel structure by means of "balancing wave tests," a special type of magnetic analysis. The committee on iron-chromium-nickel and related alloys reported that a test program is to be initiated to correlate composition, manufacturing and fabricating methods with exposure conditions. Also that attempts to prepare welding specifications have been abandoned for the time being, largely because of the controversial nature of the subject. Studies looking toward revision of the specifications for chromium-nickel steels in respect to yield point and tensile strength requirements and to the inclusion of requirements for columbium-treated 18-8 are under way.

All specifications relating to high strength wrought iron were revised by inserting mention of the method of manufacture. This reverses action taken in 1930 when the references were deleted from the process clauses of the various specifications. The new change consists in the addition of the words "pig puddled or processed wrought iron."

Impact testing

Dissatisfaction with the conventional impact test in which a V-notched specimen is subjected to a blow in the transverse direction, led the engineers at Watertown Arsenal into an investigation several years ago which resulted in discard of the transverse type for a test using a tension specimen in a machine whose velocity of impact could be varied. Also, the shape of the notch was changed to one with square shoulders. The early tests covered only specimens having notch lengths of 0.1 and 1.0 in. During the past year the test program has been expanded to cover specimens having notch lengths varying from 0.025 to 1 in. and various section diameters which, for each notched length, gave volume ratios in the order of 1, 2 and 3. Tests were made in a 300-kilogram Charpy impact machine at a velocity of 28.5 ft. per sec.

The data, presented by H. C. Mann, senior materials engineer, Watertown Arsenal, indicates the presence, within certain limits, of a linear relationship between total energy and notch length, and for any given notch length a relationship between total energy and volume of specimen. For any given notch length, the total energy is a direct function of the volume. It is held that the earlier conclusions regarding the superiority of the tension type of test specimen and the inadequacy of impact test machines which operate at one velocity are supported by the latest tests.

"It is conclusively evident from the facts presented," stated Mr. Mann, "that, as a means for determining the true dynamic properties of a material, the present generally accepted methods of impact tests are fundamentally incorrect, and have greatly retarded advancement to a thorough understanding of the subject. While there are still many phases of this problem as yet unsolved, establishing the influence of the basic factors, velocity, notch length and volume, offers a possibility for the early development of an acceptable standardization of the impact test."

In discussion, H. J. Gough, of the National Physical Laboratory of Great Britain, took emphatic exception to Mr. Mann's conclusion, and pointed out that all test investigations in England have agreed that the notch bar transverse test is not only significant but superior to the tensile test. Beyond Mr. Mann's stating that literally thousands of tests corroborate his conclusions, the debate was carried no farther.

Corrosion of metals

Discussion of corrosion in a separate session of the meeting indicated that little has been added to definite test knowledge of resistance to corrosion under field conditions, nor to knowledge of the relation between different laboratory tests and between laboratory and field tests. Of the various groups of exposure tests now in progress, the earliest dating back to 1916, none yielded significant data this year. Laboratory test data have done little more than emphasize the wide differences between corrosion under different conditions, as under intermittent immersion and under spray and mist exposure.

It is becoming recognized that knowledge of the conditions affecting atmospheric exposure is too indefinite to permit of standardizing laboratory comparison tests; the effect of dust, of rain washing, and perhaps also of electrical actions arising under outdoor exposure have not been evaluated. Field exposure tests show widely different results under exposure at different sites whose climatic conditions appear to be identical; corrosion in sea air exposure at Key West is less severe than that under like conditions at La Jolla, Calif. The consensus of the meeting was that attempts to standardize corrosion test conditions at this time would be premature. It was held, however, that certain minimum requirements concerning such tests should be set up in order to make the results of tests by different laboratories more comparable.

Present study of laboratory test methods as compared and discussed is concerned largely with investigation of the differences between different forms of tests. Many forms of test are being tried, especially by materials producers. Belief in the value of accelerated corrosion tests is decreasing however. Some hopes were held out in the discussion that study of initial rates of corrosion will produce valuable information.

Fatigue of metals

Significant progress in the field of fatigue of metals was reported by Prof. H. F. Moore, chairman of the committee. Tests by W. M. Wilson of the University of Illinois on riveted joints under axial tension and compression using a machine with a maximum range from 200,000 lb. per sq.in. tension to 200,000 lb. per sq.in. compression failed to produce failure by shear in the rivets. Failure occurred from a spreading crack starting at a bolt hole, although the calculated shearing stress was far above the shearing endurance limit of the steel in the rivets. It is not certain whether this shearing was due to friction of the rivet heads or to some other cause. Fatigue failures in the case of repeated highly-localized compressive stress, such as exists between a car wheel and a rail were also discussed. Such failures include the "shelling" of the tread of car wheels, "pitting" of gear teeth and internal fissures in rails. Failure probably originates, says the committee, as the result of a shearing stress slightly below the surface at some minute crack or other imperfection in the metal. Under intense compression, the surface layers in contact become work-hardened and therefore more brittle so that a crack might start somewhere in the transition region between the work-hardened material and the material not work-hardened. It is claimed that "shelling" does not occur after the wheel has been remachined and put back in service.

Two types of nomenclature in rather general use in this country and in England are discussed in an appendix to the committee report.

Cast iron

No changes were made in cast iron specifications but several significant test programs are planned or continuing, for example, the work on impact testing which has developed some in-

teresting results but awaits the adoption of a standard drop-test machine.

Testing of cast iron formed the subject of two papers, one by J. T. Mackenzie and C. R. Donoho (American Cast Iron Pipe Co.) on the transverse test and the other by J. O. Draffin and W. L. Collins (University of Illinois) on tensile testing. Conventional beam formulas for deflection, modulus of rupture and modulus of elasticity do not give correct results for cast iron, and results on specimens of different span lengths and different diameters are not consistent. Mackenzie and Donoho sought to determine the effect of varying span length by analysis of existing test results on round bars and by testing a number of rectangular specimens. Specimens were compared according to their span-depth ratios. Mathematical analysis of results led to the conclusions that modulus of rupture increases and modulus of elasticity decreases with increasing span and that deflection decreases much less than the conventional beam formula would indicate. The amount of the effect of changing span depends largely upon the qualities of the iron. Prof. Kommers (University of Wisconsin) said the importance of the paper was not in its findings but in the fact that it showed the need of standard specimens and standard methods of test. W. J. Schlick (Iowa State College) agreed that the results probably reflect methods of test more than characteristics of cast iron. Prof. Moore (University of Illinois) suggested that deflection readings are difficult to take accurately and that more accurate tests can be made by measuring the change of slope of the ends of the test piece. Objection was made by Prof. Withey (University of Wisconsin) to the use of the term "modulus of elasticity" in connection with cast iron; in his opinion "stiffness factor" is better.

The University of Illinois tests, involving a number of different types of tension specimens, produced the following conclusions: (1) Abrupt decreases in section weaken specimens more than surface defects; (2) Solid and hollow specimens show little difference in strength; (3) There is no difference between the strength of specimens having inside or outside threads for gripping the testing machine; (4) unloading and reloading specimens to failure has no apparent effect on tensile properties of cast iron. With respect to these conclusions Mr. Mackenzie remarked that, since high-strength cast irons would give different results, the results should be considered as applying only to the type of iron tested.

Paints

The paint session was the scene of a well-attended symposium devoted to the question of correlating accelerated laboratory tests and service tests on protective and decorative coatings. The program was divided into three topics: finishes for indoor service; paints for exterior service on wood; and paints for iron and steel. Of the 20 papers presented none expressed absolute satisfaction with correlation and about half found rather complete dissatisfaction with accelerated laboratory tests. On the other hand several papers indicated good correlation between outdoor panel tests in Florida and the laboratory tests. The general conclusion was that the weatherometer is a good research tool that could be improved if light sources more closely approximating sunlight were used and if a cycle more closely duplicating outside weather conditions could be developed. The only real test is a service test with the paint applied to the house, the tank, or the bridge.

Bituminous materials

Half a score of papers introduced by the reports of the committee on waterproofing and roofing and of the committee on road and paving materials were promptly handled at the two sessions on bituminous materials. Several new tentative standards were proposed by the committee on bituminous waterproofing and roofing materials, among them sieve analysis for granular and non-granular mineral surfacing for asphalt roofing and shingles; specifications for asphalt for damp-proofing and waterproofing to replace two obsolete specifications; and specifications for coal tar pitch for roofing, damp-proofing and waterproofing to replace a half dozen or more obsolete specifications. Studies are continuing on a proposed method for accelerated weathering tests on bituminous materials but no definite recommendations have been made. In the cycle now generally used, it is proposed to make more effective use of water, which is a very destructive agent in the weathering process. The subcommittee is now gaining experience with this modified cycle and hopes to make definite recommendations at a later date.

Directly in line with the studies on weathering were a series of tests on accelerated weathering described in a paper by R. R. Thurston of The Texas Co. Using the regulation device for accelerated tests, samples were prepared from asphalts produced from Mexican, Gulf Coast and Midcontinent crudes and also from synthetic asphalts compounded from asphaltines, resins and oils separated from a cracked residue. The results of the tests indicated rather positive influences of sources and character of the resins and oils and the quality of the asphaltines that encourage further study. A noteworthy indication is that encouraging possibilities are shown of producing synthetic asphalts for special purposes.

A wider field for the use of compression tests particularly to indicate resistance to flow was pointed out in a paper by Roland Vokac of The Barber Co. For engineering purposes, it was stated, it is more convenient to deal in terms of the applied compressive load and volume displacements than to use the more scientific consideration of rate of shear and shear stresses.

The committee on bituminous road and paving materials recommended a new specification for standard sizes of coarse aggregate for highway construction to replace existing specifications for broken stone and broken slag and sand and gravel. Numerous revisions and several withdrawals and changes in other specifications were made. Among the important revisions was one in the method of test for abrasion of gravel. Among the papers specifically on highway practice was a discussion of indentation and compression shear tests to determine the service stability of asphalt plank for bridge floors, by H. W. Greider and Henri Marc of the Philip Carey Manufacturing Co. The indentation test with standard apparatus offers, it was considered, practical and useful determinations. A review of current bituminous roadbuilding practice in western states was given in a paper by J. E. Buchanan of the

Asphalt Institute. A concluding paper on design of asphalt mixtures for underwater construction by R. M. McCrone and F. C. Field gave some new facts on recent marine works that will be summarized in a future issue.

Cement and concrete

For several years developments in the field of cement and concrete have formed a high spot on the program for the civil engineer. The meeting this year followed precedent in this respect although it did not produce the usual amount of interesting discussion. The one new specification proposed covered blended cements and this was rejected as a tentative standard by a close but small vote. The specification was unique in that it, by necessity, covered a wide range of materials used as cement admixtures and in addition stipulated that acceptable strength requirements be based on 3x6-in. concrete cylinders rather than on mortar briquets.

The blended cement specification was further notable in that it omitted the requirement for the use of the No. 200 sieve for the fineness test. In this connection, also, the committee on fineness recommended that in all specifications the "time-honored requirement for a fineness test on the No. 200 sieve, by either wet or dry method, be now abandoned" or replaced by some method that furnishes dependable information on particle size distribution or specific surface. Among the existing specifications, that for high-early-strength portland cement now requires fineness determination by the turbidimeter, that for natural cement, after revision at last week's convention, also requires the turbidimeter, while the specification for normal portland cement, after revision this year, contains no requirement covering fineness.

Among other cement specification developments was the adoption of a new revised standard for natural cement, last changed in 1909; the report that a first draft of a specification covering slag cement has been completed; and the announcement that the new subcommittee on tests of additions to cement, appointed as a result of the adoption of the new portland cement definition in the high-early-strength cement specification, has drawn up a proposed general program of tests, the details of which have been left in the hands of the Cement Reference Laboratory. The Laboratory reported that one proposed addition is now being tested in cements produced at three different mills; the necessary specimens have all been made and the test program is just getting under way.

The subcommittee on plastic mortars reported that it is trying out a concrete instead of a mortar as an acceptance test for cement. Work done so far indicates that concrete is far more plastic than the present specified mortar. In spite of its containing aggregate passing a $\frac{3}{8}$-in. and retained on a No. 4 sieve, it can readily be molded into a 2 in. cube and yields a specimen that is little subject to water losses through bleeding during the setting of the cement.

The subcommittee on volume change of portland cement has continued its studies of bars of plastic pastes which have been cured for 24 hr. under normal conditions and then subjected to elevated steam temperatures and pressures. In this connection, most of the cement manufacturers of the country have announced that they will ship no cement which has been found to have an expansion in excess of 1 per cent when subjected to a high-temperature pressure treatment. Continuing studies on the autoclave test have to do particularly with a shorter steaming cycle. New equipment for this test is now available and a series of cooperative studies in ten laboratories is being planned to develop a suitable standardized procedure.

Of the three papers presented in the concrete session, an unusually interesting one on plastic flow of concrete by Raymond E. Davis, Harmer E. Davis and Elwood H. Brown of the University of California will be abstracted in some detail in next week's issue. In the other papers Levi S. Brown (Lone Star Cement Corp.) reported a series of petrographic studies aimed to create a better understanding of the appearance of crystalline tricalcium aluminate in portland cement clinker and Prof. Herbert H. Scofield (Cornell University) discussed the results of an investigation in which 1500 specimens of concrete and mortar were frozen before or during the setting period. In the Cornell tests, the concrete frozen immediately after pouring exhibited a 40 to 60 per cent strength loss as compared with normal unfrozen concrete. The frozen specimens also showed excessive leakage in the permeability test. Mortars were less affected by freezing than concrete. The tests indicated that injury to the concrete could be eliminated by curing the specimens from 24 to 48 hours in warm air before freezing.

In the field of concrete aggregates two important new specifications were proposed and adopted. One of these, covering light-weight aggregate for concrete, has been developed in response to a need of some years' standing. According to the specification, "light-weight aggregate shall consist of pumice, lava, tufa, slag, burned clay, burned shale" and certain types of cinders. When graded according to an analysis given in the specification, the fine aggregate shall weigh not over 70 lb. per cu.ft. and the coarse aggregate 55 lb. (or 75 lb. is permitted under certain circumstances).

The second specification covers a tentative method of test for abrasion of coarse aggregate by use of the Los Angeles abrasion machine—a hollow iron drum containing an abrasive charge of steel or cast iron spheres.

An interesting announcement concerned the discontinuance of the subcommittee on admixtures. It is stated that until new information is developed, little progress can be made toward the development of specifications and methods of test covering the use of admixtures in concrete. One of the most important items that has delayed work on such specifications and tests is the lack of a test for workability of concrete.

Masonry materials

The important convention development in the field of masonry materials was the merger of the committee on hollow masonry building units with the committee on brick. Existing overlapping of the fields of these committees is thus eliminated and, inasmuch as the personnel of the two committees is practically the same, it is expected that the merger will result in greater efficiency. A new specification for paving brick

was reissued as tentative to supersede the old one, which no longer represents commercial practice. Complete revision of the specifications for building brick has been made in which the complicated method of classification and grading based upon differences in strength has been abandoned. Finally, a new tentative specification for sewer brick made from clay or shale was adopted to replace the standard specifications for clay sewer brick, which are obsolete. The new specifications are based in part upon tests made at the Bureau of Standards showing the relation of abrasive resistance to strength and water absorption of brick and in part upon the opinions of sanitary engineers.

The committee on hollow masonry building units presented a tentative specification for concrete units for non-loadbearing masonry and reported that an investigation is under way at Rensselaer Polytechnic Institute on methods of capping bonding tile.

In the brief reports of the committees on gypsum and on plastering, two items of interest are noted. The gypsum committee has modified a number of its specifications in order to include products such as lath, wallboard and sheathing board which are covered with aluminum foil. The committee on plastering is working on a tentative specification for gypsum plastering, which will be completed this year.

Brick efflorescence

One of the most important problems facing building brick producers as well as engineers and architects is efflorescence and discoloration of brick. A useful paper by J. W. McBurney and D. E. Parsons of the Bureau of Standards presented data showing the relation between the results of the wick test and the appearance of efflorescence on exposed masonry panels. The wick test consists in setting a brick on end in shallow water (0.5 in. of distilled water in the Bureau of Standards test) and permitting the portion of the brick above the water to be exposed to conditions favoring evaporation, water entering the brick by capillarity and moving upward and outward through the brick. This water tends to dissolve soluble salts in the brick and transport them to the surface, where they are deposited as efflorescence. The panels or walletes were constructed from 18 types of brick, samples of which were subjected to the five-day wick test. It was noted that:

(1) If considerable efflorescence appeared on the bricks in the 5-day wick test, masonry panels built of bricks of the same brand showed an objectionable amount of efflorescence.

(2) If the efflorescence on the bricks in the wick test was only a trace or less, most of the masonry panels built from the same brand of bricks showed only a slight amount of efflorescence.

(3) Soluble salts from mortar appeared to have caused efflorescence on some of the panels.

In discussion, observations on existing buildings were cited to indicate that the efflorescent salts cause brick spalling and are in fact a more potent cause of disintegration than freezing and thawing. Mr. McBurney stated that British investigators attribute spalling to efflorescent salts.

Timber

A tentative specification for fire retardant properties of wood for scaffolding and shoring was adopted as a result of continued efforts on the part of many in the construction industry to assist in the prevention of scaffolding fires. No new method of testing is prescribed in the specification but, by giving official recognition to the test for chemically-treated wood, devised over 30 years ago by the late Ira H. Woolson and used in New York City, it is hoped that safer construction will be promoted.

Also in the field of timber a new method of test for tar acids in creosote and creosote-coal tar solutions was presented and the tentative specifications for timber piles and for structural timbers were advanced to standard. These latter specifications are now in agreement with those of the A.R.E.A. and the A.A.S.H.O. A subcommittee is investigating the possibility of modifying the definition for knots with particular reference to hardwoods so as to clarify methods for measuring knots both in structural timber and in piles.

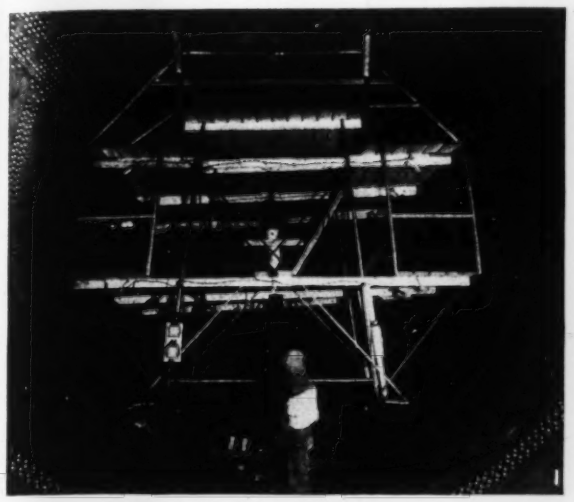
In a symposium of ten papers, representing almost as many industries and materials, the subject of measurement of consistency or viscosity was critically discussed. Most of the papers were of specialized interest, but two of them presented information of general application.

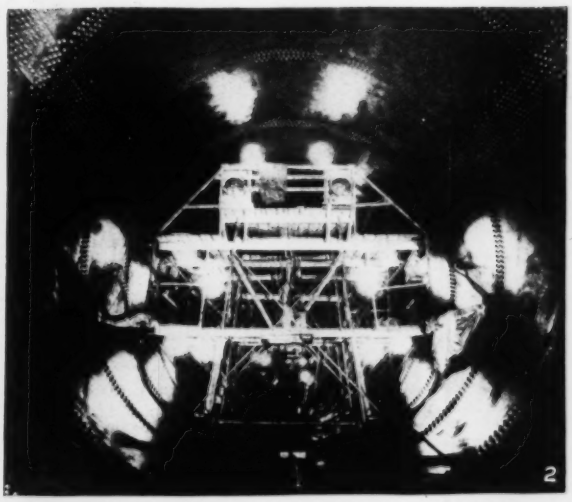
The consistency problem

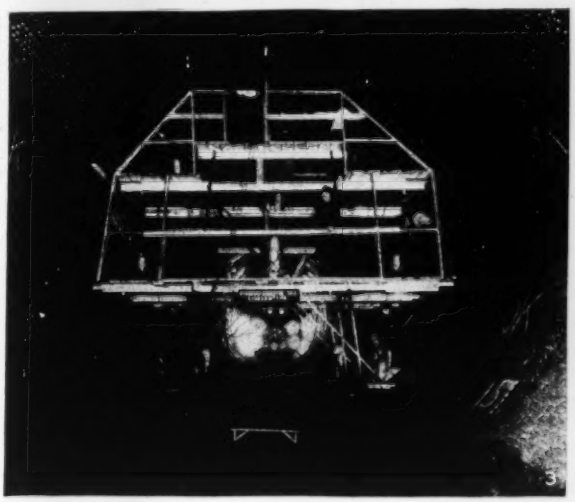
Prof. Eugene C. Bingham (Lafayette College) pointed to the international agreement on expressing kinematic viscosity in c.g.s. units, to the development of satisfactory viscometers, to the proved necessity of varying the rate of shear in studying such plastics or plastico-viscous solids as asphalt, tar and concrete, and finally to the definitions of rheological terms. M. Mooney (U. S. Rubber Products, Inc.) in presenting a paper on these definitions emphasized that the rheological diagram—the relation between shearing stress and rate of shear—is as fundamental in the field of viscous flow as the stress-strain diagram in the field of elasticity. The term viscosity applies only to simple liquids, and for those materials having more complex rheological properties the word consistency has been adopted. It is defined as the ratio of shearing stress to rate of shear and is not a constant. Materials in the civil engineering field such as concretes and asphalts fall in the classification of plastico-viscous solids. They are materials in which no deformation occurs for values of the shearing stress below a yield stress while for values above that yield stress they deform continuously.

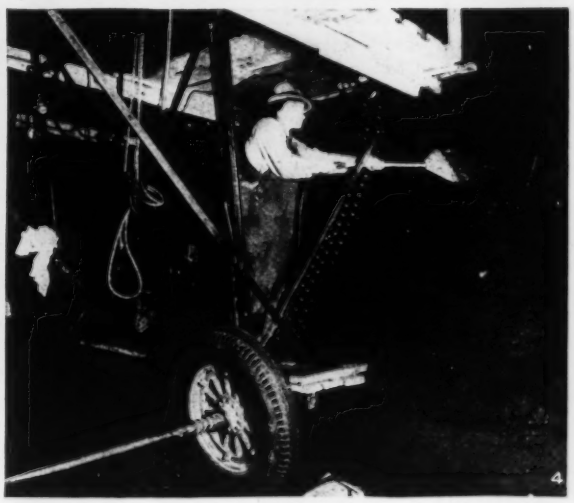
Methods of testing

The session on methods of testing produced an unusual amount of animated discussion. Particular interest was displayed in a recording electronic micrometer for measuring elastic deformations of metal as small as a millionth of an inch, described by Robert W. Carson of Instrument Specialties Co., and in a mechanism for adapting the Tuckerman optical strain gage to use in otherwise inaccessible locations. Rudolph K. Bernhard (Baldwin-Southwark Corp.) showed a motion picture of European bridge testing by vibration. A fourth paper in this session described the electrical methods by which speed control is obtained on the electrically driven testing machines at the Bureau of Standards.









Rustproofing Ft. Peck Penstock

THE STEEL-PIPE LINING of one of the four outlet tunnels for Ft. Peck Dam to provide a 24 2/3-ft. penstock for possible future power development was described in detail in *Engineering News-Record*, May 3, 1937. About 3,118 ft. of the tunnel downstream from the control gate shaft is steel lined and the inside is protected by a coating of coal-tar enamel. The plant and procedure employed in applying the protective coating are explained in the sequence of illustrations shown above. There were four operations:

1. The tunnel was cleaned from platforms on wheels by four workmen who directed powerful jets of steel grit against the rusty plates. All workmen wore hoods connected to airlines as a protection against dust and flying particles of steel and to give pure air for breathing.

2. Following the cleaning of the steel plates by blasting came a movable platform used in applying the priming coat of coal-tar paint. This material was applied cold with ordinary paint spray guns. Two blower fans on the top platform drove out the fumes from the painting process.

3. After the steel tube was cleaned and primed, this platform gantry came along on wheels to facilitate the application of the heated coal-tar enamel, which was applied by hand with dauber brushes. Each painter worked from a small electrically-heated paint pot. The inspector marked his "O.K." on each ring as it was satisfactorily completed. The floor was not painted until the return trip when the equipment was backing out of the tunnel.

4. As soon as a section of tunnel lining had been coated with hot enamel, a government inspector tested every square foot of the painted surface with an electric broom. The broom had wire bristles charged with electricity; the other half of the circuit being grounded to the lining plate. Any spot not properly coated with enamel was revealed by sparks jumping from the bristles to the plate.

The painting operations were serviced by electrically-heated melting kettles of special design that supplied coal-tar enamel at 470 deg. F. Two kettles were kept busy 24 hr. a day heating material for ten daubers on two gantries ahead. A total of 242,000 sq.ft. of steel surface in this tube were protected with enamel coating.

THE WEEK'S EVENTS

Continued from page 87

Unusual Flood in Ohio Town

(Continued from page 87)

was not flooded, although water backed up around the plant to within 3 in. of the elevation of the filter room floor. However, the sewer drain from the filters discharges into a manhole which receives the drainage from the flocculation and coagulation basins. The outlets from this manhole are into an artificial sink-hole discharging into the subterranean caverns. The water level in the caverns rose to within about 1 ft. of the ground surface around the plant and to such a height that it was impossible to discharge the wash water from the filters by gravity. Since there was no method provided for pumping the wash water in the filters to any other point, it was necessary to bypass the filters and supply the city during the period of the flood with reservoir water after chlorination. A residual chlorine content of 0.3 p.p.m. was maintained on the distribution system.

A very serious sanitation problem resulted from the flooding conditions because of th backing up of sewage which had regularly been discharged into the caverns, over the low-lying area and the inability of property owners to flush toilets on lower floors because of the height of the water in basements and around buildings.

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Bonneville Tax Case Goes to Supreme Court

Chief Justice Beam of the Oregon Supreme Court has signed an order permitting appeal of the case of Guy Atkinson Co., contractor on the Bonneville dam, against the Oregon State Tax Commission, to the Supreme Court of the United States. The case involves collection of about $250,000 of state taxes on contracting profits on Bonneville dam.

The Oregon Supreme Court denied a petition from the Atkinson Co. for a rehearing in the case (ENR June 10, 1937, p. 852).

The case arose in Multnomah county when the state attempted to collect the income tax. The company contended that since Bonneville dam was a federal project the site was exclusively under federal jurisdiction and the state could not collect taxes on profits made on the contract. The case was decided in favor of the state in the county court, and the company appealed to the state supreme court where it won a reversal. The state later obtained a rehearing of the case and obtained a decision in its favor. It was from this last decision that the company recently sought a second hearing. It is expected that the case will be tried in the U.S. Supreme Court this fall.

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California Municipalities Advance Power Payment

Advance payment of $900,000 has been made by two California municipalities, Glendale and Pasadena, on their Boulder Dam power purchase contract. Glendale has paid $500,000 and Pasadena has paid $400,000.

Under the contract, the cities were permitted to pay their share of the cost of the generating machinery at Boulder Dam over a ten-year period, with 4 per cent interest.

BRIEF NEWS

THE 3-FT. BULWARKS of boards and sand bags placed on top of the Hickman, Kentucky, sea wall during the recent flood are now being cleared. The lumber is being taken down and stacked for sale and the sand bags will be used to repair levee damage.

SAND AND GRAVEL plants in Seattle, Wash., were closed recently when a strike was called by the Street Pavers' Union. This affected all but one plant. The union asked an increase in wages of from 75 cents to $1 an hour and a reduction in hours from 44 to 33 per week.

THE TRUNK HIGHWAY from Nogales, Mexico, opposite the town of the same name in Arizona, to Guadalajara, capital of Jelisco State, Mexico, will be put under construction Aug. 1. Work will begin at the Nogales end. The sections in the Sinalo and Nayarit states will be begun Oct. 1.

THREE OLD DAMS on the Ohio River at Gallipolis, Addison and Racine, Ohio, are being blasted out of the river in anticipation of the completion of the new Gallipolis Dam this fall. The three dams, which will be replaced by the single new structure, were built at a cost of $3,000,000 each about 20 years ago.

CONTRACT for a large hydroelectric project on the Rio Negro in Uruguay has been awarded a group of firms headed by Siemens-Schuckertwerke A. G. Equipment capable of generating 500,000,000 kw.-hr. annually will be installed. The dam will create a lake covering 400 sq. mi. Some 2,500 miles of transmission lines are included in the contract.

A BRIDGE across the Mississippi River within the city limits of New Orleans is being advocated by the Louisiana Engineering Societies. The city council has been requested to appoint a committee to investigate the feasibility of such a project. The Huey Long Bridge, which now serves the city for both rail and highway traffic, is 7 miles north of town. Because the river is used by large ships the river crossings must be high and approaches would be long. Very deep piers would be required.

MEXICAN federal and state governments will spend about $85,000,000 on highway construction and allied work between now and the end of the six year plan, December 31, 1940, the Ministry of Communications and Public Works has announced. Since the start of the plan on January 1, 1934, about $14,000,000 has been spent for highway purposes.

A PUBLIC WORKS relief program has been agreed on by the City of Montreal and the Provincial Government in Quebec. Each will contribute $10,000,000, provided that the Canadian federal government also subscribes $10,000,000, and all the money will be spent on public works in the city of Montreal. Discussions with the federal authorities will begin immediately, but some doubt is felt as to the success of these conferences.

GOVERNOR RIVERS of Georgia has named the following members of the newly-created Board of Engineers and Surveyors Examiners: M. T. Singleton, Atlanta, civil engineer; R. S. King, Georgia Tech, mechanical engineer; C. J. Brockman, University of Georgia, chemical engineer; A. G. Stanford, Atlanta, electrical engineer; and C. E. Layton, Statesboro, surveyor. The Board will name its own chairman at the first meeting.

HUMAN PARKING METERS have been proposed in Akron, Ohio, as a substitute for the mechanical type. In the course of discussion by the city council of the advisability of installing parking meters, Mayor Schroy outlined a plan

to use men from the relief rolls, each to supervise ten or twenty marked off parking spaces. The men would collect five cents an hour and turn the fees into the city fund daily.

SUICIDES on the Colorado St. bridge at Pasadena, Calif. are to be prevented by erection of a 7½-ft. fence surmounted by three strands of barbed wire on which the city directors have ordered specifications. The fence, cost of which is estimated at $7,000, will be made of steel wire chain with a mesh of 1¼ in. Pasadena city officials have discussed means of making the bridge suicide-proof for several years. Many suicides have occurred there.

MUNICIPAL PURCHASE of a water system was defeated recently by voters of San Marino, Calif., by a vote of 661 to 178. The major portion of the city is now supplied with water by the California Water & Telephone Co., and it was proposed to establish a municipal system for the distribution of the Colorado River aqueduct water. San Marino is a member of the Metropolitan Water District of Southern California.

DELAYS in the construction of foundation piers for the Bird Island pumping station of the $15,000,000 Buffalo sewer system, were caused by the existence of sunken timbers at a level at which engineers had estimated bedrock would be encountered, the contractor stated when summoned to appear before the sewer authority. The difficulty necessitated construction of a cofferdam within a cofferdam and the use of much longer steel piling than had been planned.

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Herbert Wilgus Dies, New York Engineer

Herbert S. Wilgus, since 1932 principal grade separation engineer for the State Public Service Commission of New York, died July 7 in Delaware City, Del., at the age of 63.

After his graduation from Cornell University in 1901, he was assistant engineer for the Big Four Railroad in Springfield, Ohio. Subsequently he was assistant engineer for the western division of the Pennsylvania Railroad, engineer in charge of maintenance of way for the Brooklyn Rapid Transit Co., and chief engineer for the Pittsburgh Shawmut Railroad. From 1918 to 1924 he was manager of the Buckdale Coal Co. of Dubois, Pa. Before becoming grade separation engineer for the New York Public Service Commission, he had served as assistant engineer of grade crossings.

Dan Moran, Foundation Builder

As briefly reported last week, Daniel E. Moran, of Moran, Proctor & Freeman, foundation engineers, died at his home in Mendham, N. J., on July 3, at the age of 73. For some time he had suffered from heart trouble, and during the past year had been able to be

DANIEL E. MORAN

at his office but rarely, doing his professional work largely at his home. His death came a few months after the opening of the San Francisco-Oakland Bay Bridge, whose foundations of unprecedented depth and difficulty formed the climax of a career devoted to foundation engineering.

Born in Orange, N. J., on April 12, 1864, and educated at Brooklyn Polytechnic Institute and Columbia University (C.E. 1884), Mr. Moran turned to foundation problems soon after entering practice. His first experience of importance was obtained in the service of Charles Sooysmith, foundation contractor, with whom he was connected from 1889 to 1897. The firm was then sinking a mine shaft for the Chapin Mining Co. at Iron Mountain, Mich., through quicksand, using the freezing process. After completion of the shaft Mr. Moran was engineer in the construction of the Deer Island lighthouse at the entrance to Boston Harbor. He also designed for Alfred P. Boller a steel caisson 19 x 100 ft. for the McCombs Dam Bridge, New York.

Improves the airlock

During this period Mr. Moran observed the inefficiency of the airlocks then in use, and set to work to develop a safer and more practical lock. But as Mr. Sooysmith was unwilling to let him waste the firm's time on such work, he carried it on outside of office hours, and finally designed and patented a new form of airlock, in which upper and lower doors were aligned vertically, the upper ones being divided in the middle and hinged at the edges, with a central stuffing box for the bucket hoist rope. The first of these original Moran locks, built by the Continental Iron Works, was used on the McCombs Dam caisson in 1893. A bucket had got stuck in the lock with which the caisson was first equipped, and excavation from the working chamber had to be stopped until Moran's lock was placed over the shaft and the stuck bucket removed through it. The Moran lock, improved and redesigned, for a long time dominated the field of pneumatic caisson sinking and continues in wide use throughout the world.

Other early work was the design and operation of pneumatic caissons for a railway bridge at Sioux City and construction of the pneumatic caisson foundations of the American Surety Co. building, 100 Broadway, New York, the second building in the United States and perhaps in the entire world to be supported on pneumatic caissons.

From 1897 to 1899 Mr. Moran was special partner and foundation engineer of John Monks & Son, contractors. During this time he constructed and sank the caissons for the Cincinnati Waterworks.

Foundation Co. formed

In 1901 Moran with Franklin Remington and Edwin S. Jarrett formed the Foundation Company, Mr. Moran becoming vice-president and chief engineer. The new concern quickly became the leading builder of deep and difficult foundations in the United States. Up to the time he left the company Mr. Moran was in charge of many millions of dollars' worth of foundations for bridges, dams, buildings, mining shafts and other structures, and he became noted as an au-

thority in the field of foundation engineering. Two of the well known buildings whose foundations he built are the Woolworth Building and the Municipal Building in New York City.

Becomes consulting engineer

Mr. Moran established himself as consulting engineer in 1910 and continued in practice until his death. Among his works during this period were the caisson cofferdam substructures of the Equitable Building, the J. P. Morgan Building and the Federal Reserve Building in New York, as well as the mat foundation of the New York Telephone Co. building on the unusually compressible clay of Albany, the open dredging piers of the Mid-Hudson Bridge at Poughkeepsie, the pneumatic piers of the Philadelphia-Camden Bridge over the Delaware River, and the foundations of the George Washington Bridge over the Hudson, the Bayonne Bridge over the Kill van Kull, the Mississippi River Bridge at New Orleans, the Bay Bridge at San Francisco, and the Golden Gate Bridge. On the latter the firm acted as consulting engineer to the contractor in successfully completing the unusually difficult south pier foundation, built on bare rock at depths of 70 to 90 ft. in powerful tidal currents and heavy seas.

Mr. Moran was member of or consulting engineer to many boards and commissions charged with difficult problems. The list includes the Delaware River Bridge Joint Commission, a special board that reported on a vehicular tunnel between New Jersey and New York, the Port of New York Authority, the Triborough Bridge Authority, the Public Belt Railway Commission of New Orleans, and the California State Bridge Authority (Bay Bridge).

Originality and inventiveness were marked traits of Mr. Moran's personality. He was ever seeking out new paths in the solution of engineering problems, and rarely was content to follow the methods of precedent. His most recent developments were jetting wells in the open dredging caissons of the Public Belt Railroad Bridge over the Mississippi at New Orleans and the dome-roof caissons used in constructing the deep open dredging piers of the west channel crossing of the Bay Bridge, where open water 100 ft. deep and swift currents made the sinking and handling of previous types of caisson hazardous and costly.

His readiness to break with precedent was well shown in the fact that although he led in the development of pneumatic foundation methods he later consistently opposed resort to pneumatic caissons until all other foundation methods had been studied, and in recent years he built but few pneumatic foundations. The success he attained in sinking deep foundation piers for buildings in the fine sand and silt of lower New York by aid of cofferdams and drainage, and his increasing use of open dredging for difficult bridge piers, played a large part in the decrease of pneumatic foundation construction during the last decade.

His research work

Daniel E. Moran was phenomenally keen of observation, and as a result had a more thorough intuitive knowledge of soils and their behavior than anyone in his generation. He pointedly remarked, on the occasion of a celebration in honor of his seventieth birthday, that he had been privileged to look into more holes in the ground than most men, and had learned something new from each one.

Coupled with this understanding of soils was the restless spirit of the investigator. Nearly thirty years ago he began experimenting with soils, and after various settlement and compression observations on sands he noticed the progressive settlement of silt and other fine-grained material under load, and made extensive experiments on what has since become known as consolidation, rightly attributing this action to the squeezing out of water from the soil and observing that the volumetric consolidation equaled the volume of water expelled. Mr. Moran also noticed the large settlements that frequently developed in loose-textured sand, and recognized them as due to the sand structure.

Many distinctions were bestowed on Mr. Moran, among them degrees of Master of Science and Doctor of Science from Columbia University and a gold medal for eminent achievement.

Admired and loved for his personal qualities as well as for his technical achievements, "Dan" Moran was above all a practical foundation builder of unerring judgment and decision. His undisputed rank as leader of foundation engineering in the United States testified to the genius and unremitting effort that he applied to his special field of work.

PERSONAL

WALLACE L. BRAUN is now traffic engineer for the city of Baltimore.

FRANCIS J. MCDONALD has been appointed project engineer in the offices of the state highway department in Franklin, Pa.

JOE CARNEY is now city engineer for Blythville, Ark.

C. C. STEVENSON, city engineer at Boise, Idaho, for 25 years, has retired.

J. F. MCBIRNEY became city engineer of Boise, Idaho, June 1.

JOSEPH LEBLANC has been appointed superintendent of roads for the city of Montreal.

L. M. FREDERICK has been instructor in civil engineering at Toledo University in Toledo, Ohio.

L. W. HINE, Akron, is general superintendent of WPA projects in Coshocton county, Ohio.

J. EDWARDS, JR., is now superintendent of the Monongah division of the Baltimore & Ohio Railway.

GEORGE H. MASSEY is District of Columbia and Maryland representative for the Kentucky Rock Asphalt Institute.

LEO L. LAINE has become Memphis resident engineer of the U. S. Geological Survey, succeeding H. G. Thomasson.

H. G. THOMASSON, Memphis resident engineer of the U. S. Geological Survey since August 1936, has been transferred to Fort Smith, Ark.

J. SCOTT HARRISON, fourth district U. S. cadastral engineer at Helena, Mont., has retired after 34 years of service.

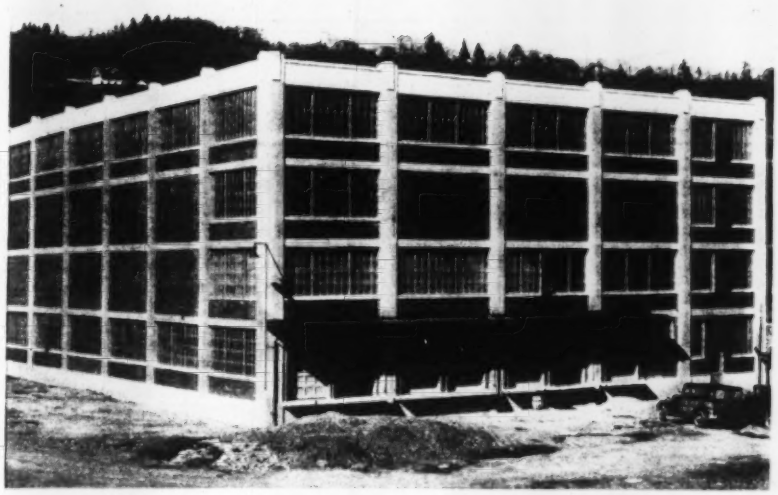
HUGO ZAPP, assistant county engineer for Harris county, Houston, Texas, has been named county engineer, term extending to Jan. 1, 1938.

H. C. TILZEY, Missoula, Mont., division engineer of the Montana highway department for the past six years, is now construction engineer of the highway department at Helena.

C. D. WILLIAMS, formerly in the engineering department of the New York Central Railroad, is an associate professor of structural engineering at Fenn College, Cleveland.

MAJOR GEORGE J. NOLD, engineer in charge of the Albany office of the U. S. Engineers since the first of the year, has been assigned as district engineer of the newly created Binghamton district office, effective July 1.

WALTER WINTERS has been appointed Whatcom county engineer at Bellingham, Wash. He has been chief deputy



AGFA ANSCO COMPLETES NEW FILM WAREHOUSE

FILM WAREHOUSE embodying many modern features has been completed by the Agfa Ansco Corp. at Binghamton, N. Y. As requirements for a warehouse for finished goods in the film industry are almost as exacting as those of a manufacturing plant proper, the features of this warehouse include an automatic freight elevator, highly modern air conditioning and humidifying systems, and carefully designed precautions against sweating of walls and windows. Since Binghamton has experienced two serious floods in recent years, the lower floor of the warehouse, which is exposed to this danger, will be used for packing, shipping and similar operations, while the upper floors will serve for the storage of film, paper, chemicals, cameras and other photographic accessories. All electric wiring below flood level is waterproof.

Thurston county engineer at Olympia, Wash., for the past seven years.

ED. J. HENEN is city engineer at Great Falls, Mont.

OBITUARY

GILBERT R. MILES, city engineer of Olean, N. Y., died June 30.

WALTON ROWTON, 54, construction engineer, died recently in Lakewood, Ohio.

ERNEST H. HULL, civil engineer and naval architect, died recently in New York at the age of 54.

RALPH W. HOLT, for many years a prominent contractor and architect at Nashua, N. H., died there June 30 following an automobile accident.

GUY A. BYARS, district engineer of the 9th Road District of Kentucky, was killed in an automobile accident June 30, near Harlan, Ky. Mr. Byars was 52 years old.

FRANK TWEEDY, former topographic engineer in the United States Geological Survey, who spent forty-three years in the service of the government, died July 5 in Washington at the age of 83.

FRANK E. MCCONNELL, 47, civil engineer and former consulting engineer on several government projects, including the preliminary work on Boulder Dam, died June 21.

ALLAN J. MCDOUGALD, retired Montreal railroad contractor, died there June 16 at the age of 61. Mr. McDougald was engaged in building a section of the National Transcontinental R. R. (now part of the C. N. R.) in Western Ontario.

WILLIAM T. MARTERSTECK, 67, Lakewood, Ohio, construction engineer, died recently in Cleveland. He was engineer in charge of an addition to the Massillon Rolling Mills in 1914 and before that was chief engineer of the Sharon Steel Hoop Co., Youngstown, Ohio.

CHARLES BROSSMANN, Indianapolis consulting engineer, died June 30 at Monticello, Ind., at the age of 60. Mr. Brossmann did most of his consulting work in waterworks systems, power plants and sewage treatment works. For more than twenty years he was secretary of the Indiana Engineering Society, and at the time of his death was president of the Indiana Section of the American Society of Civil Engineers.

CHARLES C. FOLSOM, 55, engineer in charge of improvement work on the Missouri river from Rulo, Nebr., to St. Louis, died in Kansas City recently.

CALENDAR OF MEETINGS

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Detroit, Mich., July 21-24.

AMERICAN WATER WORKS ASSOCIATION, Central States Section, Dearborn, Mich., August 18-20; North Carolina Section, Wilmington, N. C., August 26-28, Rocky Mountain Section, Santa Fe, N. M., September 20-22.

CALIFORNIA SEWAGE WORKS ASSOCIATION, annual convention, San Jose, Cal., September 13-14.

NEW ENGLAND WATER WORKS ASSOCIATION, annual convention, Poland Spring, Me., September 21-24.

OFFICERS ELECTED

HAROLD W. HUDSON has been elected president of the New York Section, Metropolitan section of the American Society of Civil Engineers. Other officers elected are: R. E. Bakenhus, vice-president; J. F. Langthorn, treasurer; Joseph W. Barker, William Heyman, Thorndike Saville, directors. The above officers, together with Harry D. Winsor, vice-president; William J. Shea, secretary; George W. Burpee, Victor Gelineau, and E. P. Goodrich, directors; and Van Tuyl Boughton and Leslie G. Holleran, past presidents, comprise the board of directors for the year 1937-38.

THOMAS J. SKINKER is president of the Engineers Club of St. Louis.

AIR-CONDITIONING regulations will be sought by the National Conference of Building Officials, which met in Cleveland early in June. Frank C. Keller, president, of New York City, announced at the meeting that he would appoint a committee to work with the American Society of Heating and Ventilating Engineers on such regulations.

FRED L. PLUMMER, consulting engineer and associate professor of structural engineering at the Case School of Applied Science, has been elected president of the Cleveland Engineering Society, and Ward Harrison, director of engineering, General Electric Co., is vice-president.

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

HIGHWAY CONSTRUCTION, GEORGIA

OWNER: Georgia Highway Dept.; Federal aid project.

PROJECT: Construction of 12.5 miles of bituminous surfacing and three bridges, including 160,383 cu.yd. excavation on the Macon-Columbus highway in Talbot Co. Ga.

BIDS: Five bids were opened June 4, 1937, ranging from contract low of $278.116 to a high of $296,081, with contract scheduled for completion within 250 days and minimum hourly wage rates stipulated of 20c. for common and 50c. for skilled labor and all materials required for construction furnished by the contractor.

LOW BIDDERS:

1. J. W. Gwinn Co. Inc., Birmingham, Ala. (contract) $278.116
2. Hardway Const. Co. Columbus, Ga. 290.961
3. W. L. Cobb Const. Co. Decatur, Ga. 292.126

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clear & grub	147.906 acre	$40.60	$24.34	$50.70
2. Clear & grub	12.800 acre	75.00	50.00	50.00
3. Excav. unclass., borrow	147,700 c. y.	.31	.28	.27
4. Selec. material, shoulder	unit c. y.	.31	.65	.35
5. Ditch excav.	10,423 c. y.	.50	.40	.35
6. Channel excav.	1,525 c. y.	.80	1.00	.75
7. Excav. clvt. type struct.	735 c. y.	1.00	1.00	1.00
8. Hydraul. settlement	11,304 c. y.	.04	.05	.04
9. Overhaul, excavation	24,857 st. y.	.015	.015	.015
10. Pipe SD, 15 in.	1,100 l. f.	1.30	1.10	1.25
11. Pipe SD, 18 in.	160 l. f.	1.40	1.75	1.40
12. Pipe CD, 18 in.	298 l. f.	1.30	1.75	1.40
13. Pipe CD, ext. 18 in.	814 l. f.	1.65	1.75	1.50
14. Pipe CD, ext. 24 in.	478 l. f.	2.40	3.00	2.50
15. Pipe CD, ext. 30 in.	10 l. f.	4.00	5.00	3.50
16. C. M. pipe, SD, ext. 15 in.	100 l. f.	1.30	1.75	1.50
17. C. M. pipe, SD, ext. 18 in.	10 l. f.	1.50	2.50	2.00
18. Remove, store guard rail	6,102 l. f.	.10	.25	.15
19. Remove clvt. pipe	165 l. f.	.60	.50	.50
20. Remove, relay clvt. pipe	829 l. f.	1.00	1.00	.75
21. Conc. Cl. B. hdwls., steps	283.07 c. y.	25.00	24.00	22.00
22. Conc. Cl. A. clvts.	538.796 c. y.	28.00	24.00	22.00
23. Conc. Cl. B. hdwls. removed	37.04 c. y.	4.00	5.00	5.00
24. Conc. Cl. A. clvts. removed	148.95 c. y.	5.00	5.00	5.00
25. Bar reinf. steel	38,987 lb.	.055	.05	.06
26. Plain riprap	112 c. y.	3.50	4.00	7.00
27. Grass slopes, shoulders	180,438 s. y.	.015	.025	.02
28. Conc. R W markers	95 ea.	2.50	2.00	2.00
29. Arrows, FAP markers	2 ea.	3.00	5.00	5.00
30. Select mat'l. shoulders	11,097 c. y.	1.00	7.00	5.00
31. Local stone ditch checks	172.9 c. y.	3.00	5.00	5.00
32. Remove wood bridge	l. s.	.50	1.00	.50
33. Remove wood box	40 l. f.	.25	1.00	.50
34. Reset conc. R W markers	46 ea.	1.00	1.00	1.00
35. Spillways, conc., type 4	2 ea.	25.00	50.00	25.00
36. Slope drain, conc.	17 l. f.	1.50	1.00	1.00
37. Sidewalk, conc. 4 in.	36 s. y.	1.50	2.00	2.00
38. Remove conc. steps	2.75 c. y.	4.00	10.00	5.00
39. Remove rip rap	9.5 c. y.	3.00	2.00	5.00
40. Remove rubble hdwls.	1.5 c. y.	3.00	5.00	5.00
41. Remove corr. metal spillways	4 s. y.	1.00	5.00	7.50
42. Remove, rebuild stone wall	90 l. f.	1.00	5.00	10.00
43. Raised edge curb	262 l. f.	.12	.25	.10
44. Doweled conc. curb, 6 in.	64.66 l. f.	.50	.50	.50
45. Bituminous prime	63,997 gal.	.14	.155	.14
46. Hot bitumen	81,917 gal.	.105	.11	.095
47. Bituminous seal	58,547 gal.	.11	.11	.12
48. Coarse agg. cover mat	4,390 ton	3.90	4.50	3.90
49. Fine agg. cover mat	1,763 ton	4.10	4.50	4.00
50. Finish, dress	146,338 s. y.	.02	.03	.02
51. Guard rail, type A, B	6,109 l. f.	.75	.90	.75
52. Comp. el. grav. base, 8 in.	162,601 s. y.	.55	.59	.68
53. Reinf. conc. approach slab	160.02 s. y.	4.00	5.00	4.00
54. Conc. header, 6x8 in.	84 l. f.	1.00	.50	1.00
55. Sod ditch checks	1,829 s. y.	.05	.60	.50
56. Spreader boards	10,096 l. f.	.06	.15	.05
57. Remove, reset FAP markers	2 ea.	1.00	3.00	4.00
BRIDGE CONSTRUCTION				
1. Conc. Cl. A	212 c. y.	$30.00	$27.50	$25.00
2. Reinf. steel	40,800 lb.	.06	.05	.05
3. Struct. steel, bridge No. 1	l. s.	1,800.00	1,600.00	1,800.00
4. Treated timber, No. 16	2.8 M.b.m.	130.00	140.00	150.00
5. Pile timber treated No. 16	960 l. f.	1.50	1.75	1.50
6. Riprap	900 s. y.	3.00	2.00	2.00
7. Remove old bridge	l. s.	300.00	600.00	350.00
8. Test piles	2 ea.	150.00	100.00	100.00
9. Clear, grub	0.761 acre	100.00	150.00	500.00
10. Concrete paving, 4 in.	448 s. y.	1.50	1.50	1.50
11. Re-use Fr. 2, riprap	l. s.	500.00	1,500.00	500.00
12. Re-use Br. 3, riprap	l. s.	500.00	1,500.00	500.00

GRADE CROSSING, MAINE

OWNER: State Highway Commission; L. D. Barrows, Chief Engineer, Augusta, Me.

PROJECT: Construction of 376 ft. crossing 18 ft. above B&M.RR. 3½ miles from Biddeford on Route 1. Structure and approaches total 1970 ft. overall, the former comprising a 6 span continuous I-beam bridge with 2 roadway lanes 22 ft. each, and 2-3 ft. sidewalks.

BIDS: Opened June 2, 1937. Six were received on the structural steel portion and 12 on the concrete with the former ranging from a low of $42,800 to a high of $50,720 and the latter from $139,215 to $229,902.

CONDITIONS: Contract is scheduled for completion in 180 days with minimum wage rates stipulated of 40c. per hr. for common and 80c. for skilled labor. Borings indicate 10 ft. firm clay overlying muck to ledge and due to 35 ft. fill a relief ditch will be dug through the clay and into the muck at toe of slope to relieve fill pressure and allow muck displacement. All materials and labor other than for steel field painting to be furnished by contractor.

LOW BIDDERS: (Structural steel)

1. American Bridge Co. Boston, Mass. $42.800
2. Bethlehem Steel Co. Bethlehem, Pa. 43.280
3. Harris Struct. Steel Co. New York, N. Y. 48.800

(Concrete and earthwork)

1. Concrete Const. Co. & Cerulli Const. Co. Chelsea, Mass. $139.215
2. Dominic M. Bernardi, Wellesley, Mass. 140.547
3. Wyman & Simpson Inc. Augusta, Me. 147.127

Item	Quan.	Unit Prices (1)	(2)	(3)
CONCRETE AND EARTHWORK				
1. Maintain traffic	l. s.	$2,000.00	$1,000.00	$4,650.00
2. Channel diversion	150 c. y.	.60	1.00	1.00
3. Cofferdams	l. s.	700.00	800.00	240.00
4. Piles, round wooden	2,000 l. f.	.71	.50	.60
5. Concrete in abutments	230 c. y.	7.75	14.00	10.00
6. Concrete in piers	440 c. y.	8.80	14.00	12.00
7. Conc. roadway, s. w. slabs.	1,210 c. y.	18.64	14.00	19.70
8. Conc. wearing surface	170 c. y.	12.40	10.00	7.00
9. Concrete rail	734 l. f.	3.26	2.00	3.00
10. Cement	3,700 bbl.	2.50	2.56	2.70
11. Reinf. steel, furnish	264,000 lb.	.0543	.035	.04
12. Reinf. steel, set	264,000 lb.	.014	.0075	.01
13. Backfill	350 c. y.	.50	.60	1.00
14. Fill in approaches	115,000 c. y.	.30	.39	.35
15. Gravel base	3,500 c. y.	.75	.50	.70
16. Gravel surfacing	700 c. y.	1.00	.60	1.30
17. Bit. macad. surfacing	570 c. y.	5.00	4.60	5.50
18. Guard rail	2,250 l. f.	.60	.38	.46
19. Anchorages, bridge	4 ea.	15.00	12.00	20.00
20. Anchorages, outside	4 ea.	15.00	9.00	10.00
21. Building tile	1,000 c. f.	.71	.32	1.00
22. Steel hangers	6,500 lb.	.11	.14	.13
23. Wire mesh	32,000 s. f.	.067	.05	.04
24. Cast iron drains	8 ea.	50.00	45.00	20.00
25. Steel piles, 53 lb.	2,800 l. f.	2.20	2.10	2.10
26. Steel piles, 42 lb.	2,800 l. f.	1.75	1.70	1.75
27. Steel pile caps	9,200 lb.	.036	.115	.06
28. Concrete culvert	260 c. y.	9.08	8.00	13.00
29. Loam	1,400 c. y.	1.00	1.00	1.50
30. Sodding	1,260 s. y.	1.10	.60	.60
31. Timber drains, chutes	9 M.b.m.	124.30	80.00	50.00
32. Excav. relief ditches	6,000 c. y.	.60	1.15	.40
33. Remove conc. driveway	270 c. y.	1.00	7.00	4.50
34. Cobble gutter	400 s. y.	2.00	2.00	2.00
35. Conc. culvert headwalls	4 c. y.	5.75	18.00	20.00
36. Remove top slab, culvert	l. s.	50.00	100.00	60.00
37. Excav. structures	1,000 c. y.	.50	1.25	1.00
38. Excav. pipe culv. struct.	300 c. y.	.50	1.25	1.50
39. Seeding	115 M.s.f.	4.00	5.00	6.00
40. Fill relief ditch	4,000 c. y.	.50	.50	.85
41. Emulsified asphalt	20,000 gal.	.14	.12	.15
42. Reinf. conc. pipe, 18 in.	72 l. f.	3.00	3.00	2.20
STRUCTURAL STEEL				
43. Struct. steel, riveted	800,000 lb.	.043	.0441	.0445
44. Erection, struct. steel	800,000 lb.	.01	.01	.0165

(Additional Contract Unit Prices on second following page)